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THE UNTILLED FIELD OF CHEMISTRY[1]

Two years ago, upon a similar occasion, it was my privilege to address many of you and to point out some of the relationships existing between the chemist and the community. In so doing, there naturally devolved upon me the pleasant duty of recalling to your minds a few of the great and more significant achievements of members of our profession by way of indicating, although briefly and most inadequately, something of the extent to which the chemist has already placed the community in his debt. It is good for any body of men, animated by a common purpose, to take, from time to time, mental stock of what they have accomplished and of the relation in which they really stand to their environment. Where, as in our own case, the record is one of which we all may well be proud, its contemplation brings a new sense of the dignity of the work itself, a pride of fellowship and an incentive to increased endeavor.

We move, however, in a world where it is easy to take much for granted, where symbols and conventions quickly come to take the place of the realities they represent. Our mental processes are apt to run along the line of least resistance and the apparent and the obvious obscure the fundamental truths. This being so, we can well afford to leave our achievements in the security of the past while we consider for the moment the things we have left undone.

The volume of chemical literature has become so great, so many compounds have

[1] Address of chairman of the Division of Industrial Chemists and Chemical Engineers, Baltimore, December 29, 1908.

been described and classified, so many methods have been laid down, so much detail confronts the student, and his field of study has been so subdivided as to suggest and foster the delusion that the total sum of chemical knowledge must be vast indeed. Vast in its detail perhaps it is, but lacking in those fundamental unities which out of the confusion of detail bring wisdom. Chemistry still awaits its Newton. It still justifies the estimate of Kant, who said of it more than one hundred years ago:

> Chemistry is a science, but not a science in the highest sense of that word; that is a knowledge of Nature reduced to mathematical mechanics.

Despite the immense amount of dry detail which we have accumulated, and in some measure correlated, chemistry is still in the imaginative era where generalizations are more the result of happy inspiration than of close mathematical analysis.

Chemistry concerns itself with the changes which matter undergoes in its varying relations to certain forms of energy and yet we do not know what matter is nor have we any conception of the real nature of energy. One has only to state in their ultimate terms the problems confronting us to bring a realization of how very far from their solution we still stand. They are, for instance, thus summarized by Karl Pearson: *What is it that moves? Why does it move? How does it move?* Where, yet, I ask you is their answer to be found in chemistry?

We have built our science upon the assumption that matter, whatever that may be, is composed of indivisible atoms, of a comfortable and ultimate simplicity, only to find that the atom is in fact divisible and that its structure is undoubtedly complex beyond imagination. As to those phases of energy which are concerned with chemical change, even so great a philosophical chemist as Ostwald says:

> Chemical energy is to us the least known of all the various forms, as we can measure neither it nor any of its factors directly. The only means of obtaining information regarding it is to transform it into another species of energy.

So we have gone on for a hundred and fifty years transforming chemical energy into electrical energy or into heat, making minutely refined measurements of the relatively small amounts of energy appearing in our processes, while wholly unconscious all this time of the stupendous stores of potential energy which we now vaguely begin to realize are bound up in matter.

Our study of matter has led us to teach that it manifests itself in some seventy distinct and separate forms which we call elements, and yet our very definition of an element is a confession of our failure. An element is something which we have not been able to decompose into anything simpler. We have discovered some curious and interesting relationships between the elements which point to their common origin. In his heart each one of us believes that they must have had a common origin and that the cycles of development which they exhibit can only have resulted from the action of a periodic variable upon a constant, and yet we very rarely even consider the question of their genesis or why their properties are what they are. We are content to regard them as so many distinct creations. The discovery of a new element is hailed as marking an epoch in the history of our science when our real business should be the elimination of the elements as such.

In their interactions, the elements, as we know them, manifest valences and selective affinities which determine the course of all chemical change, and yet we are without an acceptable working hypothesis of the cause and nature of either valence or chemical affinity. Our ideas regarding the constitution of the molecules of many

compounds have been developed in great detail and have led us to so many happy conclusions which the facts have verified as to justify our belief that these ideas must rest upon a substantial basis of truth. This sometimes leads us to forget that the graphic formulas which we build up and write on a plane surface are an attempt to represent in terms of two dimensions actualities which exist in three. Moreover, these formulas depict the molecule as something fixed and rigid, although everything tells us that the atoms within the molecule are in rapid and ceaseless motion. A new chemistry will dawn when we take proper cognizance of these motions and their influence upon the properties and relations of the compound. We state molecular weights with a finality of assurance, forgetting that we know very little of the molecular weights of liquids and nothing of the molecular weights of solids. We write cellulose as $(C_6H_{10}O_5)_n$ but the unknown n is probably the most significant part of the entire formula.

Sulphur passes before our eyes from the crystalline to the amorphous variety, phosphorus assumes the red or yellow form, and an almost complete change of properties attends the transformation. Carbon exists in several markedly different states, and yet as to the meaning and mechanism of these molecular changes we remain in complete ignorance. Fortunately for the comfort or even the very fact of our existence upon the planet, water is denser at 4° than it is at zero. Had it not been so, our lakes and oceans would be simply so many solid ice masses upon which the summer sun could make only a superficial impression, but, in spite of the paramount importance of the fact itself no one of us can say why the water molecule presents this curious anomaly. We write the water molecule as H_2O and commonly regard it as a relatively simple compound. How then shall we account for the fact that the dielectric constant or specific inductive capacity of water is about fifty times that of air, or perhaps ten times that of glass. As the dielectric constant is in a sense a direct measure of the massiveness of the molecule, are we not forced to the conclusion that the water molecule really is built up of many of these H_2O groups? How else, indeed, shall we explain the power of water to knock asunder the molecules of electrolytes which it dissolves, and does not this complexity of the water molecule bear some relation to the essential part which water plays in the ultimate phenomena of living matter?

And this brings me to the main point of my thesis. A great German chemical company tells us in an attractive book just issued that it employs 218 chemists, 142 civil engineers, 918 officials, and nearly 8,000 workmen. It covers an area of 220 hectares, has 386 steam engines, 472 electric motors, and 411 telephone substations. Its plant represents the highest development which industrial chemistry has reached, but, none the less it can not produce an ounce of starch which a potato growing in the ground fabricates from water and carbonic acid gas under the influence of sunshine.

True it is that this great aggregation of engines and dynamos, furnaces, retorts and stills, can, under the direction of its highly trained and specialized chemical staff, produce certain natural products in condition so available and pure as to even improve upon nature, but by what monstrous effort is it accomplished? In the spring the tender grass and the delicate unfolding leaves cover the whole earth with the green of chlorophyll. There is no noise, no smoke, no stench. The grass is cool and grateful to the touch, and clean. In similar manner vegetation everywhere is fabricating cellulose to the extent of sev-

eral billion tons each year, and not only cellulose, but all the countless other complex products of the vegetable cell. What shall we say of our own chemistry in the face of facts like these, except that we have gone far enough to encourage a faint hope that we may some day be able to approach such methods. Professor Wheeler has defined so clearly a thought which has been in my own mind for years that I can not do better than quote his words. He says:

> The vegetable cell is a laboratory in which are carried out a most remarkable series of chemical reactions. As we contemplate the immense number of organic compounds of all degrees of complexity which are formed within this wall of the plant cell we are convinced that this is the chemical laboratory *par excellence*. Two features impress us particularly; first, the silence in which the operations are carried on; second, the narrow range of medium temperatures required. Notwithstanding this apparent simplicity of conditions, the products are of the most various kind. Some of these man is able to synthesize in his own crude way; others are still the secrets of nature. It is utterly impossible for man to prepare certain naturally occurring compounds except at a temperature which would burn the plant tissue. We are led to wonder whether forces exist with which we are unacquainted or whether we are merely unable to control the forces already familiar to us. It would be difficult to say which supposition is the more probable. It will be granted that investigation into the activities of the cell is of profound importance. In fact it has been said that "it is in the plant cell where synthetical operations are predominant, that we have to look for the foundation of the 'new chemistry' which may be expressed broadly as the relation of matter to life."

I expressed two years ago my own belief that the distinctions which we now regard as fundamental between living matter and dead matter would soon break down. This break will, in my opinion, come through the study of the colloids which are the link between matter which we regard as living and that which we regard as dead. At this point, I can not refrain from volunteering a suggestion. We know that the atoms within the molecule are in rotation. It must follow that as the complexity of the molecule increases more and more of its motion of translation must be converted into rotary motion. In the colloidal molecule we know that many simpler molecules are linked together, and in the molecule of living matter, what? May it not be merely that the more or less haphazard and confined movements of the molecules, which together build up the colloid, are in the molecule of living matter coordinated and controlled in a manner which suggests the vortex. Dead matter drawn within this vortex would partake of this movement and exhibit the phenomena of life. Matter thrown off tangentially would resume its rectilinear course and become, for the moment, dead.

When we consider that in theory at least, in which accidents are barred, a tiny bit of living jelly, an amœba for example, can endow with life an ocean of its proper pabulum, it seems obvious that the forces which are to manifest themselves in the phenomena of life are already existent in the pabulum, and that what the living jelly does is to induce a coordination and direction of the atomic movements which then take on the vital aspect. Do we not have something roughly analogous to this in the magnetization of successive pieces of steel drawn across a lodestone? A certain coordination of movement in the molecules of the steel has been induced and magnetism results. So in some manner far more complex life, I believe, may be epitomized as coordinated motion.

The subject-matter of such speculations lies so far outside our present-day chemistry as to almost require apology for their presentation, but they are well within the subject-matter of the chemistry of the future, for, to again quote the words of Pearson:

The goal of science is clear; it is nothing short of the complete interpretation of the universe.

Or as Muir has put it:

The great business of chemistry is to force men into close contact with some aspects of external realities and, with the help of her sister sciences, to remove everything that prevents the full vision of nature.

ARTHUR D. LITTLE

THE FUNCTION AND FUTURE OF THE TECHNICAL COLLEGE[1]

THAT the education of the child through the first eight years of school should be at the public expense is a matter generally accepted as fundamental by every intelligent voter in this country. There are, however, those who insist that public funds should not be used in carrying on schools of secondary rank; and that the expense of college or advanced technical training should be met and universities sustained by the state is a proposition many would combat. The teaching of trades at public expense, a matter that a few years since was considered impossible by trades unions and society generally, is slowly but surely making its way in this country. If we are to witness, in the next decade, such advances in the scientific, commercial and industrial world as would appear commensurate with the progress of the past ten years, it will be largely due to the work of the technical schools, and colleges of science and engineering—institutions under state control as well as those on private foundations.

As the opportunity and field for such institutions are becoming vastly greater and broader and the need for technically trained men more and more apparent, the fact is also clear that the training in such schools is too narrow and restricted. This is but the natural revolt against the old scholasticism. From a college training in letters merely, the tendency has been strongly marked in the opposite direction, and pure science and technique in the abstract has characterized the technical courses.

In these institutions men must be prepared, not alone to carry out the will of another; not simply to be exact machines to execute the plans presented to them. The product of these schools must possess initiative, imagination, individuality; they must be experts, leaders, investigators, executives; they must plan and lead, not follow merely; they must create as well as construct. In other words, continued progress means that technical education must produce executive engineers and industrial experts. For these men of the future we must rely upon the endowed institutions, of which there are all too few of high grade, as well as upon public institutions ranking with the former and offering all the advantages of study and research.

The time will soon be upon us when, forced to sustain a much greater population than we now have, and owing to keen competition with foreign countries, the industrial and commercial development of this nation will demand experts in many lines. The depleting of our forests not only robs us of timber needful in developing the arts, but in certain sections of the country will so affect the water supply as to produce regions dry and arid; the storing of water in reservoirs for purposes of power, consumption and irrigation is a matter hardly yet begun; the building of railroads, canals, electric lines; the bridging of rivers and the draining of swamps; the constructing of a system of highways and thoroughfares from city to city and throughout rural districts; the development of scientific farming, the greatest industry before our people to-day; the building of harbors; the perfecting of our great mining industries; these are some of the enter-

[1] Elaboration of an address before the Technical Education Department of the National Education Association, July, 1907.

prises for which trained men are needed, and the technical school must furnish them.

In using the term "technical college," there is implied a more extended field than that covered by the college of engineering as the latter is generally understood. In its broad aspects the technical college comprehends work in general science, in mechanical, electrical and civil engineering, mining and chemical engineering, hydraulics, architecture, steam, marine and railway engineering, sanitary science, forestry, agriculture, horticulture and the various subdivisions of these comprehensive and inclusive phases of scientific and industrial life.

The very breaking up of any one of these several branches or subjects gives us at once the clew to the necessity for more intensive and more extended work in the departments they represent and shows clearly the necessity for training an increasingly large number of competent men. While many who might pursue technical courses are far removed from the special school, still the duty of extending and carrying on the work must rest in no small degree with these schools, as so few state institutions at present offer adequate courses in these lines.

In the old days before electricity was used as motive power or for purposes of illumination, when building construction was almost entirely with wood, and work in the arts demanded at best small quantities of iron and steel with little stone or brick and no concrete, when work by hand had not been supplanted by the labor-saving mechanical devices, when problems of transportation by land and water, of heating, lighting, water supply, sewerage and drainage, of bridge and road building, of scientific agriculture were as yet undeveloped, the demand for technical education was small. In the mechanical world the civil engineer was the man of the hour. He who could establish a grade or construct a single span was in the front rank. Mechanical and electrical engineering courses, as such, were in embryo. The work of the mining engineer was done by rule of thumb. The "cut and try" method was applied in chemistry and architecture. Sanitary science was in an elementary stage. The study of hydraulics was theoretical rather than applied. Forestry, agriculture and horticulture were carried on in the belief that "nature must take her own course."

But the application of scientific principles in the arts and industries has made possible an evolution that has resulted in a revolution. More and more we have differentiated our lines of work, until what originally appeared to be a field in itself is now broken up, and the expert is he who spends a lifetime upon only one of the problems of a given field of knowledge. As Willam C. Gannett says: "The man of science, and to-day more than ever, if he would add to the world's knowledge, or even get a reputation, must be, in some one branch at least, a plodding specialist."

There is, however, to this argument another side that must be considered. While in an earlier day the work was of a general character, and the special phases of science as yet undeveloped, this very specialization of which we have been speaking has brought about a strong reaction. Constant touch with the special phases of work, concentration upon a comparatively narrow field of human interest, can not but have its effect upon the individual. This fact receives abundant exemplification constantly and illustrations need not be multiplied. Too often we find the technical expert or man of science a technical expert merely. If by nature he is narrow, his training in the schools only tends to enhance this narrowness. Of art or letters, music or drama, he knows little and cares

less. Business is a bore, history a closed book, and he has little in common with society and men and things. As the world develops he knows of this development, if at all, only from the standpoint of the growth of his own science. If he attempts aught outside his field, he fails.

This, then, is the anomaly. That while in the early days of applied science, to be an engineer implied a general knowledge of such principles of the subject as were known, the development of scientific and technical thought and appreciation and the birth of many courses produced extreme specialization. Hence we find the scientific man of to-day troubles himself, not so much with the broad phases of the subject as with a specific part. We have already reached the danger point and the *machine* engineer, the natural result of our present system, must soon be displaced by the *thinking* engineer. The artisan is to go down before the artist-artisan. Thought must take precedence over imitation. The necessity for a broader and more general knowledge upon which the specialty may with safety be constructed, is the argument here being presented.

With this main issue in mind, let us turn for a moment to the consideration of the number of high-grade institutions in this country wherein are offered courses of a technical nature.

A detailed study shows that out of forty-two state universities (the total number in the United States), thirty-six offer technical and engineering courses. Of other colleges and universities of a public, endowed or private character, there are sixty-three offering such courses, while there are forty-five special schools of technology and science; in all a total of one hundred and forty-four institutions offering technological courses.

Of the thirty-six state universities offering these courses, six only may be classed as of the first order. Six of the sixty-three additional colleges rank as first-class institutions, while fourteen of the forty-five special schools of technology are in class one. In this latter number, the Naval Academy at Annapolis and the Military Academy at West Point are included.

Of the six state universities mentioned, all offer courses in electrical, civil and mechanical engineering, three offer courses in architecture, five in chemical engineering, four in agriculture, three in sanitary, two in mining and three in railway engineering, two in metallurgical engineering, one in naval architecture, two in forestry, one in marine engineering, one in irrigation and one in ceramics.

The six additional colleges of public and private nature offer courses as follows: six in electrical, six in civil and five in mechanical engineering, three in architecture, three in chemical engineering, two in agriculture, two in sanitary, four in mining and three in railway engineering, one in metallurgical engineering, two in naval architecture, two in forestry, two in marine engineering and one in horticulture.

In the fourteen special schools of technology, we find nine offering courses in electrical, eight in civil and nine in mechanical engineering, five in architecture, three in agriculture, two in sanitary, five in mining, one in metallurgical and five in chemical engineering, one in forestry, one in railway engineering, one in naval architecture, one in horticulture and one in ceramics.

This gives us a total for the twenty-six educational institutions of twenty-one offering courses in electrical and twenty each in civil and mechanical engineering, eleven each in architecture and chemical engineering, nine in agriculture, seven in sanitary, eleven in mining, seven in railway and five in metallurgical engineering, four in naval architecture, five in forestry, three in ma-

rine engineering, two in horticulture, one in irrigation and three in ceramics.

The combined courses offered by state universities, other public and private colleges, and the special technical schools (one hundred and forty-four institutions) are as follows: ninety-one in electrical, one hundred and thirteen in civil and ninety-four in mechanical engineering, twenty in architecture, fifty-nine in agriculture, fourteen in sanitary, fifty-two in mining, four in marine, ten in metallurgical, thirty-four in chemical and seven in railway engineering, four in naval architecture, four in irrigation, nine in forestry, twelve in horticulture, five in textiles, and five in ceramics.

These facts show the meager opportunities offered for intensive technical work, especially in the light of our rapidly developing resources. The mere fact that there are one hundred and forty-four institutions where education of the character indicated may be had, is not at all an answer to the point made. In most of these institutions calling themselves colleges, and in many of which the traditional subjects are well taken care of, the equipment, the location, the general facilities and the character of the instruction given in technical lines are not such as to fit for leadership or for executive positions, or to equip for expert work, nor are the humanities always so taught as to develop richness of mind.

What has been said of the narrowing influences of courses of study in schools of technology of to-day, applies in greater or less measure to every such institution in the country. Even those of greatest reputation are not free from this criticism. Some of these colleges are breaking the bonds of tradition and are broadening their curricula. The fact remains, however, that if we are to equip, *not machines, but men,* if the product of the school is to be first a man and then an engineer, it follows that the conservative measures of the past must be disregarded and that we must demand a more logical treatment of our technical college schedules.

That the training given in the technical college be not over narrow and restricted, to the science, mathematics, drawing and shop work must be added such of the humanities as experience may show to be essential. The graduate of an engineering college or of a school of technology frequently finds himself in possession of sufficient facts connected with his profession, but with a knowledge of the language he uses so inadequate as to seriously handicap him in pursuing his vocation. The business side of his education he also finds, when too late, has been sadly neglected. To adequately express oneself and to perfectly understand all business forms, such as papers of conveyance, deeds, bills of lading, etc., are matters to be ignorant of which is absolutely inexcusable. Details of common law, training in questions of national and political economy, of general history and of commercial geography are fundamentally essential.

Herein is where the failure is so often made. The specialist can perform the task allotted to him, he can construct the plant, install the equipment, but can go no further. The management of the enterprise, the business side of the project, he can not grasp. For this purpose a business man is required, and the latter, having no acquaintance with the technical features involved, makes failure of his administration. The engineer must be an executive engineer. His training must be such as to enable him to tie together the various specialties. He must understand accounting and know how to make proper apportionments; in other words, he must be familiar with the commercial phases of his profession; he must have a knowledge of business methods, of political and economic conditions, of the development of trade and in-

dustry. He must know thoroughly the commercial side of his problem.

But if technical courses are thus broadened, adjustment must be made somewhere. No more can be crowded into the four years now required for graduation from a technical or engineering school. Must, then, these additional lines of work be demanded of technical students, and if so, how shall the schedules be adjusted?

Three alternatives present themselves as partial answer to the last question. First, the lengthening of the professional course to five or six years, making it graduate in character and on a par with graduate or professional schools of medicine or law. Second, the adding of two years to the present high-school courses now preparing for advanced technical work, thus enabling students to enter the technical college upon a much better foundation than at present. Third, the elimination of the non-essentials from the present four years' courses, thus leaving more time for additional necessary work.

The argument advanced by advocates of the first method is that the four years of regular college work is not sufficient. That to be adequately trained implies ultimately the lengthening of the college course to five or six years. Each year brings a greater store of knowledge to be taught and with this additional knowledge comes the understanding that to push the man through his course is to start him on the road to inefficiency. Especially must those who are to be leaders, the "trail blazers," the executives, the experts, be given advantage of a longer course.

The claim is made that after eliminating the non-essentials there will not be sufficient time in which to present the subjects of the special line being pursued and such of the humanities or so-called culture subjects as were previously suggested. English alone must be granted considerable time, as an appreciation of good literature, a taste for the best that has been written, is essential to growth, whoever the man and whatever his profession. The student who in school and regardless of his trend of thought, is not given the opportunity of putting himself on friendly terms with the best in literature, is being robbed of one of the tools most necessary to advancement, and an element of the greatest pleasure and profit. On the other hand, so much must be added each year, as the discoveries and developments in science are made, that these alone may more than compensate for the eliminations.

Considering the second point, it would seem that there are many and strong arguments in favor of the lengthening of the high-school course to six years, such arguments applying with equal force to both traditional and manual-training high schools. But the lengthening of the preparatory course implies at once one of three alternatives. (1) A six-year preparatory course, in which the subjects are of secondary grade, without regard to lengthening of the college course thereafter. (2) A six-year preparatory course wherein certain preliminary college work is taken up, the regular college course to be either two years or four years in length. (3) A six-year course to be followed by a six-year college course. These propositions will receive no extended consideration at this time.

If the proper equipment and courses could be supplied in the high school, the students had better spend six years therein, as many who seek the technical and engineering college are so immature as to be unable to adjust themselves to the changed atmosphere, and go down and out in the first few weeks of school. Many have not found their level on leaving high school and are not adapted to the work to which they aspire. At much less expense than at

college, less danger, and with a better opportunity to "try out" his powers and determine his inclinations, the boy may spend his added two years in high school.

It happens many times that the moral atmosphere of the college is undesirable, especially so to the boy fresh from the small high school. Moreover, the quality of the instruction offered in the first two years of many of the larger institutions is far inferior in grade to that which may be had in the well-conducted high school.

On the successful completion of these two years of work, a diploma should be given. It would then be possible to advise the student as to whether or not further college work would be to his advantage.

While there is much truth in the foregoing argument, it remains to be said that it is next to impossible, under present conditions, to induce those best qualified for the work to continue more than four years beyond the secondary school. Considering the readjustment of schedules, it is certain that there are many husks that may be thrown out. This matter of elimination must be taken up from the very beginnings in school work. All along the line (perhaps in the technical school less than elsewhere) much time is spent upon those things that are neither practical nor cultural. Then, too, it is quite as common an error to underestimate the ability of the student as to overestimate it, and much that is now *taught* would be *absorbed* without regard to teacher or course of study if the student were allowed to do so.

Year by year, new discoveries and researches, greater advances and broader developments, add a vast fund of material to the technical courses. Since there is a maximum limit to the years one should spend in training, we must constantly trim away the unnecessary material. Only the essentials can remain, and through organization and systematization, through careful selection and concentration of effort, not only may the student in training get from his four years at school more than he now receives of the technical side of his work, but he may also broaden his vision and become better prepared than he now is to take up the duties of his profession. For, to quote MacDonald in Sir Gibbie:

> There is a great deal more to be got out of things than is generally got out of them whether the thing be a chapter in the Bible or a yellow turnip, and the marvel is that those who use the most material should so often be those that show the least result in strength of character.

Through this readjustment more shop work may be given than is now offered. In some schools the time devoted to shop courses is at a minimum, the idea being that a knowledge of shop processes can be gained later. To prepare fully for technical work the various shop processes should be understood, even though they be not taken up in detail, that the proper connections may be made. Considerable attention should be given to the construction of apparatus, instruments and machines. In the technical school is offered the best of opportunities for reconciling the methods of commerce with those of the educator. The two should dovetail.

There is another reason why every student in a technical school should have contact with and thoroughly master each machine and process. Too often the graduate of the school seeks a position in the office or at the desk. He does not believe in hardening his hands or soiling his clothes. He has not been in the habit of "taking off his coat" while in school. The student who has mastered the shop process has learned how to work, and appreciates the joy of working, and he is neither afraid nor ashamed to begin his professional career in an inferior position and thus lay the foundation for advancement.

All technical college courses then, under

these conditions, would be rather more topical and more intensive than at present, leaving much repetition and detail, and particularly those subjects that will not find application later on, to be taken up by the student at his option, after leaving the school.

But to develop technical courses to the point of greatest efficiency it will not only be necessary to offer a suitable program of studies, and to perfect an organization and equipment, but instruction must come from men who are broadly trained, scholarly and cultured, who are educational experts and administrators and who have achieved success in their fields of work. To secure such men it will be necessary to offer financial consideration such as to induce them to enter the educational arena instead of devoting their time to commercial practise.

A study of the engineering college will show that everywhere, and especially in Germany, a strong reaction is taking place, and the feeling is growing, that a well-trained engineer must be a man broad in his sympathies and possessing a knowledge of people and things that shall give him place anywhere and always. The Emperor William on the occasion of the Charlottenburg celebration used these words to indicate what was, to his mind, the connection between the technical high school and the engineering college:

> In the relation of the technical high schools to the other highest educational establishments, there is no opposition of interests, and no other competition than this, that each of them and every member of them for his own part, should do full justice to the claims of life and science, mindful of the words of Goethe: "Neither to be like the other, but each alike to the highest." How is this to be done? Let each be complete in itself.

Finally, in the technical college as elsewhere, the ultimate purpose of the training offered is for service. But the service rendered must be given, not with the hope of material gain only or of selfish reward. Recent events in our own country have shown us most clearly a regrettable lack in our present social attitude. We have men —trained specialists, professional, commercial, technical—and we need more of them, but if we are to meet successfully the present state of social unrest and solve the economic, political and moral problems that confront us, these must be men of broad vision; men who realize the needs of society and are willing to assume to the full their individual and joint responsibilities. The college of engineering must do its part by broadening its purely technical character on the lines which I have attempted to indicate.

But the proper results in technical education can not be obtained without work and there will be much opposition. We must be open-minded always, definite in our purposes and willing to stand alone if in the right. What Burke says of Parliament finds application with us in America, whether it be in politics, in the religious world or in education:

> Their one proper concern is the interest of the whole body politic, and the true democratic representative is not the cringing, fawning tool of the caucus or the mob, but he who rising to the full stature of political manhood, does not take orders but offers guidance.

A. H. CHAMBERLAIN
THROOP POLYTECHNIC INSTITUTE

RECENT SANITARY LEGISLATION IN KANSAS

As an illustration of the advanced work that is being done in the interests of sanitation throughout the middle west, a report on the recent legislation, affecting the Kansas State Board of Health, may be of interest.

1. At the recent session of the legislature an amendment to the present Food and Drugs Law was passed, largely increasing the authority of the Board in making rules and regulations, and defining standards of purity and strength for quality of foods and drugs.

2. A comprehensive law was passed, providing for sanitary inspection in places where

foods and drugs are prepared, sold or offered for sale. This is in line with the recommendations of the State and National Food and Dairy Departments.

3. An amendment to the Water and Sewage Law was passed, revising the definition of sewage so as to include industrial wastes, and giving the Board of Health authority over the operation, as well as the installation of both old and new water plants and sewage systems, also, providing for investigations concerning purity of water supply and the pollution of streams.

4. A comprehensive and stringent Weights and Measures Law was passed, authorizing the inspectors of the Food and Drugs Department to be inspectors of weights and measures, and charging them to assist in the enforcement of the law.

5. There was passed what is believed to be an effective hotel inspection law, with special attention to fire escapes, sanitary conditions, cleanliness, disinfection of rooms and sanitary supervision over places where foods are prepared.

6. Four important laws were passed, looking toward tuberculosis control in the state. One of these laws requires compulsory confidential reports of all cases; another is intended to control tuberculosis in animals; another refers to spitting in public places; and a fourth appropriates $10,000 a year for an educational campaign for the supervision and prevention of tuberculosis.

7. A law was passed revising the general health laws, pertaining to health officers, and among other things empowering the State Board of Health to remove a county health officer for neglecting, or refusing, to perform the duties of his office.

This legislation will add very much to the powers already possessed by the State Board of Health, and they will be able, to a greater extent than ever before, to contend effectively with disease.

E. H. S. Bailey

IN OKLAHOMA

The following is from the *Oklahoma City Times* of April 23:

Despite the fact that all the business transacted by the board of regents of the Oklahoma Agricultural and Mechanical College at Stillwater in its meeting April 13 to 15, has been kept secret, the fact has leaked out that the board decided on a wholesale dismissal of instructors.

As a result of the dismissals many are declaring that the action was taken in order that firmer supporters of the Haskell state administration might be elevated to positions which carry good salaries.

It is known that ten of the instructors in the schools have received notice of their dismissals, and that the new selections of the board will soon be named for their places.

Among those who have been dismissed are:

George H. Holter, professor in chemistry, who has held his position in the school with credit for seventeen years.

O. M. Morris, professor in botany and horticulture, who is a graduate of the school, class of 1896 and who graduated in his specialties from Cornell in 1897.

E. E. Balcomb, who is in charge of the agricultural work, which the school provides for the common schools of the state. Professor Balcomb was appointed by the same board last year.

James W. Means, professor in mathematics.

R. Rosensteingel, assistant in electrical engineering.

C. Beathy, in charge of chemistry in the experiment station. He is one of the appointees of the present board.

J. F. Lawrence, instructor in mathematics.

R. P. Sauerhering, assistant in mechanical engineering.

H. S. Weatherby, assistant in chemistry.

Miss C. H. Snapp, instructor in English, one of the board's own appointees.

It is reported that the board of regents of the university has resolved to confer the degree of doctor of laws on Mr. Linebaugh, the regent, at whose request the notorious letter from the Rev. Mr. Morgan was written accusing members of the faculty of dancing and card playing. The board has passed the following resolutions:

Whereas, the University of Oklahoma belongs to all the people of the state and should be conducted in such a way that the humblest citizen can not justly criticize it or any member of the faculty, and

Whereas, a goodly number of our citizens very

seriously object to members of the faculty engaging in the public and indiscriminate dance and card parties;

Therefore, be it resolved by the board of Regents, in regular session in the city of Norman, April 2 and 3, 1909, that we request the members of the faculty of this university to refrain from these amusements during their connection with this university.

Resolved further, that the president of the university be requested to furnish each member of the faculty with a copy of this resolution.

BUILDING FOR SCIENTIFIC, EDUCATIONAL, PATRIOTIC AND OTHER ORGANIZATIONS IN WASHINGTON

AT the meeting of the National Academy of Sciences on April 21, 1909, the question of the lack of proper accommodations in the Smithsonian building for the National Academy, the American Association for the Advancement of Science, and other national and local scientific organizations was brought up by the Secretary of the Smithsonian Institution.

Secretary Walcott explained that the headquarters of the National Academy, the American Association for the Advancement of Science and the American Historical Association are in the Smithsonian Institution building; that three other bodies have applied for space, but there is no more room available and there is no place in Washington available for large scientific gatherings, such as would come together at meetings of the American Association for the Advancement of Science, and scientific congresses on various subjects. There will be better facilities in the new National Museum building, but there will be inadequate facilities for large meetings and congresses. He then called attention to the memorial building proposed by the George Washington Memorial Association. The general scheme as outlined by the association is to erect a great memorial building to George Washington in recognition of his strong desire expressed in his farewell address: "Promote then, as an object of primary importance, institutions for the general diffusion of knowledge"; also, "the promotion of science and literature."

The memorial association circular states that the building

will be dedicated to the increase and diffusion of knowledge in all lines of human activity that will conduce to the advancement of the welfare of mankind.

The building is to be well located, attractive in appearance, practical in plan and construction, and of the most durable character. It is to be planned so as to furnish a home and gathering place for *National, Patriotic, Scientific, Educational, Literary and Art Organizations* that may need such accommodations, including the Washington Academy of Sciences and its sixteen affiliated societies. It will furnish a place where all the Patriotic Societies both north and south may testify to their love for the Father of this Country. The building will contain a great hall or auditorium and rooms for large congresses, such as the recent Tuberculosis Congress; rooms for small and large meetings; office rooms and students' research rooms.

Primarily the basis of this movement is a patriotic one. The nation needs a headquarters for its great national organizations engaged in bringing the people in closer touch with each other, in all that pertains to patriotism and increase of knowledge that will make better and stronger men and women, physically, mentally and morally.

All the national and local organizations mentioned may have their offices in the proposed building and be liable only for their personal expenses, as it is planned that an endowment fund for the maintenance of the building shall also be collected.

The George Washington Memorial Association has $25,000 in its permanent fund and $5,000 for expenses. It is planning to organize in every state through state chairmen and to obtain funds by contributions of one dollar or more.

The memorial association recently elected Mrs. Susan Whitney Dimock, of New York, president, and the following advisory council has been appointed: Hon. Elihu Root, President Ira Remsen, Professor H. Fairfield Osborn, General Horace Porter, President Chas. J. Dabney, Dr. Charles D. Walcott, Mr. Charles J. Bell.

Mr. Charles J. Bell is the trustee of the permanent fund.

It was further explained that the memorial association is not working under an agreement with any educational or other institution but that it desired the cooperation of all organizations and individuals interested in its purpose.

After full consideration the National Academy of Sciences unanimously adopted the following resolution:

Resolved, That the National Academy of Sciences give its approval to the general plan of the George Washington Memorial Association to collect funds for the purpose of erecting and maintaining in the city of Washington a building adapted for a meeting place of scientific organizations.

The Washington Academy of Sciences has had the matter under consideration for some time through its building committee. On April 20 its board of managers recommended active cooperation with the memorial association and at a meeting of the academy, April 24, the following resolutions were adopted:

Resolved, that, in the opinion of the Washington Academy of Sciences, the efforts of the George Washington Memorial Association to provide suitable facilities in the city of Washington for bringing together the national patriotic, scientific, educational, literary and art organizations that may need such accommodations, including the Washington Academy of Sciences and its affiliated societies, deserves commendation and support.

Resolved, that the academy considers it eminently desirable that we should commemorate the interest felt by our first president in science and the higher education, and that no better method can be found than to provide, in the city which bears his name, the capital of the nation, a suitable meeting place for all engaged in the advancement of the welfare of the human race.

Resolved, that the academy appoint a special committee to cooperate in this important movement by all practicable methods.

Resolved, that the academy recommends to each of the affiliated societies that it appoint a similar committee to cooperate with the committee of the academy.

The Washington Academy has appointed its building committee, Dr. George M. Kober, chairman, as its effective agency to take the matter up with the members of the academy and affiliated societies and the citizens of Washington.

SCIENTIFIC NOTES AND NEWS

Professor George E. Hale, Mount Wilson; Professor Santiago Ramón y Cajal, Madrid; Professor Émile Picard, Paris, and Professor Hugo Kronecker, Berne, have been elected foreign members of the Royal Society.

The following new members have been elected to the American Philosophical Society: Louis A. Bauer, William Howard Taft, Washington, D. C.; Marston Taylor Bogert, Hermon Carey Bumpus, Dr. Alexis Carrel, A. V. Williams Jackson, New York; Edwin Brant Frost, Williams Bay, Wis.; Robert Almer Harper, Charles Richard Van Hise, Madison, Wis.; William Herbert Hobbs, Victor Clarence Vaughan, Ann Arbor, Mich.; Abbott Lawrence Lowell, Boston; William Romaine Newbold, John Frederick Lewis, Charles Bingham Penrose, Philadelphia; Francis Darwin, Cambridge, England; Hermann Diels, Emil Fischer, Berlin; Friedrich Kohlrausch, Marburg; Wilhelm F. Ph. Pfeffer, Leipzig.

M. Pierre Termier, professor of mineralogy in the Paris School of Mines, has been elected a member of the Paris Academy of Sciences in the place of the late M. Gaudry.

Professor Wilhelm Ostwald, the eminent chemist, has been awarded by the University of Christiania its first Cato M. Guldberg medal.

Subscriptions to the Charles W. Eliot fund have been received from about 2,050 graduates of Harvard University and others, and amount at this time to about $130,000. The subscribers have sent subscriptions as follows: 858, $5 and under; 500, $10 to $20; 418, $25 to $50; 189, $100 to $250; 58, $250 to $500; 31, $1,000 to $10,000. The committee hopes that the fund will amount to more than $150,000 by May 10, when President Eliot retires. The subscriptions have been placed in the hands of trustees, to invest and hold for the benefit of President and Mrs. Eliot. The fund will eventually pass to Harvard University.

Dr. Eugen Wolf has been promoted to the directorship of the Senckenberg Museum of

Natural History at Frankfort, in succession to the late Dr. Roemer.

DR. PAUL POPPENHEIM has been appointed custodian in the Zoological Museum at Berlin.

MR. JOHN HEWITT, of Jesus College, Cambridge, has been appointed assistant for molluscs and fishes at the Transvaal Museum, Pretoria. For the last four years Mr. Hewitt has been curator of Rajah Brooke's Museum at Sarawak.

DR. RICHARD PRAGER, of Berlin, has been appointed head of the computing division, and Dr. Walter Zurhellen, of Bonn, head of the astrophotographic department in the Observatory of Santiago de Chile.

DR. EDWARD R. WALTERS has been appointed director of the Department of Health and Charities at Pittsburg.

PROFESSOR WILHELM HITTORF, the eminent physicist of Munich, has celebrated his eighty-fifth birthday.

DR. H. GRENACHER, professor of zoology at Halle, has retired from active service.

PROFESSOR A. LAWRENCE ROTCH, director of the Blue Hill Observatory, has returned from attending the International Aeronautical Commission at Monte Carlo.

DR. MAXIME BÔCHER, professor of mathematics at Harvard University, expects to spend the coming academic year abroad.

PROFESSOR H. E. CRAMPTON, of Columbia University and the American Museum of Natural History, will take his fourth voyage to the Society Islands this summer. Later he will go by way of Cook's Islands to New Zealand and the Samoan group via the Tonga Islands. He will return by way of the Fiji Islands and Hawaii, arriving home in January, 1910.

THE advanced students of geology at the University of Wisconsin left on April 30 for a ten days' trip through the iron and copper districts of Wisconsin, Minnesota and Michigan. Accompanied by Professors C. K. Leith, E. C. Holden and A. N. Winchell, they will be joined en route by Professor More, of Chicago, and a group of Chicago students; by Professors Mansfield, Cline and Sauer, of Northwestern and their students; and by a member of the Canadian Geological Survey, Mr. Collins, of Ottawa, Canada. Starting from Duluth, the party will go through Tower and the Vermilion range; Biwabik and the Mesabi range; Carlton, Minn.; Houghton, Mich.; Ishpeming and the Marquette district, returning to Madison May 10.

PROFESSOR WM. A. LOCY, of Northwestern University, delivered the principal address before the Iowa State Academy of Science at Iowa City on the evening of April 30. His subject was "The Service of Zoology to Intellectual Progress."

DR. ALEXANDER GRAHAM BELL was announced to read on the evening of May 7 before the American Philosophical Society a paper on "Aerial Locomotion."

PROFESSOR WALTER R. CRANE, of the Pennsylvania State College, will read a paper on "The Use of Concrete in Mine Support" before the Institution of Mining Engineers meeting in London on May 28.

PROFESSOR GEORGE B. FRANKFORTER, dean of the college of chemistry at the University of Minnesota, lectured at the University of Wisconsin on April 30 on "Utilization of Waste Products from the Lumbering Industry."

PRESIDENT CHARLES R. VAN HISE, of the University of Wisconsin, has announced a course of instruction to be given next year in the geological department, on the conservation of natural resources. Dr. Van Hise's administrative duties have until now prevented his resuming teaching.

IN the fern herbarium of the New York Botanical Garden, which is now officially called the Underwood Fern Herbarium, a bronze tablet in his memory has been erected bearing the following inscription:

THE
UNDERWOOD FERN HERBARIUM
NAMED IN HONOR OF
LUCIEN MARCUS UNDERWOOD
1853–1907
CHAIRMAN OF THE SCIENTIFIC DIRECTORS
1901–1907

IN memory of the late Professor Mendeleef, it is proposed to establish in St. Petersburg a

Mendeleef Institution to contain chemical and physical laboratories and a museum.

Dr. Alexander Krakau, professor of electrochemistry at the University of St. Petersburg, died on March 29.

The death is also announced of Professor F. E. Hulme, professor of mechanical drawing at King's College, London, and the author of several well-known books on wild flowers.

The Society of German Chemists will hold its annual meeting at Frankfort from September 14 to 18.

Under the provisions of the program of administrative reform in preparation for constitutional government, the ministry of the Interior of the Chinese Empire has issued regulations governing the taking of a census of all Chinese, both at home and abroad. There will be a census of families and also of individuals. The former is to be completed in 1910 and the latter not later than 1912.

The Academy of Science of St. Louis is bringing together an endowment fund of $15,000, the income from which is to ensure continued publication of its long-established *Transactions*. To an invested fund of $3,000 the council has added $1,000 from the treasury and members have contributed an additional $2,500. Of the remaining $8,500, $5,000 have already been subscribed.

Over a ton and a quarter of rare earths has been presented to Professor Victor Lenher, of the department of chemistry of the University of Wisconsin, by the largest manufacturer of gas mantles in this country. The gift was made in recognition of the work on those substances which has been carried on for some years by Professor Lenher. The greatest quantity of monazite sand, which contains the rare earths in crude form, is found in North Carolina, the source of supply for all North American manufacture of gas mantles, as Brazil is the source for European manufacture. In the form of a by-product of gas mantle manufacture, the earths look like white flour, and it is in this form of oxalates that the 2,500 pounds given Professor Lenher are stored in barrels in the chemistry building of the university. A number of graduate students at the university, under the direction of Professor Lenher, are devoting their efforts to various investigations of the rare earths. Three of these, Professor C. W. Stoddart, of the soils department of the agricultural college; Professor Raymond C. Benner, of the University of Arizona, who took his degree of master of arts at the University of Wisconsin in 1905; and Charles W. Hill, assistant in chemistry at the university, are at present making such investigations the subject of their dissertations for the doctor's degree.

According to the *Westminster Gazette* the late Mr. John Murdock, who resided at Craiglockhart, in the county of Midlothian, by his will directed his trustees to employ the residue of his estate "in instituting and carrying on a scheme for the relief of indigent bachelors and widows, of whatever religious denomination or belief they may be, who have shown practical sympathy either as amateurs or professionals in the pursuit of science in any of its branches, whose lives have been characterized by sobriety, morality and industry, and who are not less than fifty-five years of age." The trustees notify that they are prepared to grant donations or pensions to persons "who have done something in the way of promoting or helping some branch of science" and who otherwise conform to the requirements of the trust.

We are requested to state that the Royal Observatory of Belgium at Uccle is arranging to publish a list of the magnetic and seismological observatories of the world, together with a list of societies and reviews concerned with terrestrial magnetism, atmospheric electricity and seismology, and that information that will make these lists as complete as possible will be gladly received.

Mr. J. H. Gregory, '50, of Marblehead, has presented to Amherst College some 1,500 Indian implements, which include specimens from South Carolina, the Connecticut Valley and Marblehead. This collection consists largely of spears, arrowheads, hatchets and other implements of the southern Indians col-

lected by Mr. Gregory nearly fifty years ago, when he was a student at a theological seminary in South Carolina.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Washington, Seattle, will receive by appropriation of the state legislature the sum of $673,000 for maintenance, for the biennium, 1909–11. Four permanent brick structures: an auditorium, a chemical laboratory, an engineering building, a power plant; and two semi-permanent structures: a library and forestry building will lapse to the university after being used by the Alaska-Yukon-Pacific Exposition, this summer.

MR. ANDREW CARNEGIE, in commemoration of twenty-five years' work in bacteriology and pathology done by the Carnegie Medical Laboratory of New York University, has given $75,000 to the school. The money will be applied to the extension of the present Carnegie Laboratory building by an addition to it, which will face on First Avenue, the present building fronting on East Twenty-sixth street.

THE legislature of Nebraska in its recent session appropriated $20,000 for the purchase of a new site in Omaha for the college of medicine of the University of Nebraska. The citizens of Omaha are to erect the buildings on the site thus obtained. The hall of mechanical engineering of the university is approaching completion and will be ready for occupancy in September. At a recent meeting of the regents the sum of $50,000 was set aside for equipment. The regents are taking steps to locate two additional experiment sub-stations, as provided by the recent legislature. One of these is to be in the "Sandhill Region" of central Nebraska, and the other in the "Irrigation Region" of the western part of the state. They are contemplating considerable additions to the campus by the purchase of adjacent property. This has been made necessary by the present overcrowded condition of the campus. The tuition fees hitherto required of graduate students who are not residents of the state have been abolished.

THE Boston *Evening Transcript* states that plans are maturing for the establishment of a medical school in China. The promoters are Harvard men who intend to go to China at the expiration of their hospital appointments, having definite invitations from his excellency the viceroy of the Kiang Soo province. An endowment fund will be raised to be held by a board of trustees in this country, incorporated to direct the financial affairs of the institution. President Charles W. Eliot, of Harvard, has consented to serve as chairman of this board, and his associate trustees will be Dr. H. P. Walcott, Dr. A. T. Cabot, Dr. W. T. Councilman, Dr. W. B. Cannon, Dean H. A. Christian and Professor E. C. Moore. These are the men who intend to go: Drs. J. P. Leake, W. S. Whittemore, W. H. Hitlner, I. Hartshorn, C. C. Haskell, M. R. Edwards, A. L. Patch, A. M. Dunlap, G. P. Gaunt and C. A. Hedblom.

A DESPATCH from Denver to the daily papers says: "Differences between the members of the faculty and the board of trustees of Westminster University, Denver, Col., a Presbyterian institution, arising out of a general reduction of instructors' salaries, have resulted in the dismissal of President Joseph L. Weaver and the entire faculty. The reduction caused President Weaver and the faculty to bring suit for back pay, and the dismissal followed."

DR. WILLIAM A. SHANKLIN will be inaugurated as president of Wesleyan University on October 29. He will, however, assume the duties of the office after the close of the present academic year.

DR. CHARLES E. BESSEY, who has been for many years the dean of the industrial college of the University of Nebraska, has been promoted to be head dean of the university. He is chairman of the board of deans, and becomes the acting chancellor whenever the chancellor is absent or indisposed.

MR. C. T. BRUES, curator of invertebrate zoology in the Milwaukee Public Museum, Milwaukee, Wis., has been appointed instructor in economic entomology at the Bussey Institution of Harvard University.

Dr. J. Frank Daniel, late at Johns Hopkins University, now working at the Pasteur Institute at Lille, France, has been appointed instructor in zoology at the University of Michigan, to succeed Dr. Dana B. Casteel.

Dr. Emil Bose, of Danzig, has been appointed professor of physics in the University of La Plata.

Professor J. Bauschinger has been appointed to succeed Professor E. Becker as professor of astronomy and director of the university observatory at Strassburg.

Dr. Einar Hertzsprung, of Copenhagen, has been appointed associate professor of astronomy and astrophysics at Göttingen.

DISCUSSION AND CORRESPONDENCE

INDUSTRIAL FELLOWSHIPS

The incidental reference made by Professor Kipping in his address before the British Association to a scheme of industrial fellowships which I have initiated in this university has led to so many inquiries from industrial chemists and to such general interest that I am compelled to present now its main outlines and present status rather than to wait, as I had intended, until its material results had determined fully its practicability. The scheme was initiated through an article entitled "Temporary Industrial Fellowships" which was published in the *North American Review* for May, 1907. This article was subsequently included as the last chapter in a book called "The Chemistry of Commerce" (Harper's). The scheme as then evolved has developed as I gained experience into something somewhat different; while it is essentially the same, I have found it practicable to claim on behalf of the university more advantages than I at first thought possible. Perhaps the present nature of the scheme is better exemplified in one of the later fellowship agreements, for example in Fellowship No. 7:

For the purpose of promoting the increase of useful knowledge, the University of Kansas accepts from the A. B. C. Glass Company, having head offices at New York, the foundation of a temporary industrial fellowship to be known as the A. B. C. Fellowship.

It is mutually understood and agreed that the conditions governing this fellowship shall be as follows:

The exclusive purpose of this fellowship is an investigation into the optical properties of glass in relation to its chemical constitution, to the furtherance of which the holder shall give his whole time and attention, with the exception of three hours a week, which he shall give to work of instruction in the chemical department.

The fellow shall be appointed by the chancellor of the university, the director of the chemical department and the professor of industrial chemistry; he shall have made previously a reputation in research; he shall be a member of the university, and shall pay all regular fees with the exception of fees for laboratory and supplies, for which his instruction shall be taken in lieu, unless in the opinion of the appointers his demands become excessive, in which case the donor shall be expected to reimburse the university; he shall work under the advice and direction of the professor of industrial chemistry; and he shall forward, periodically, through the professor of industrial chemistry, reports of the progress of his work to the A. B. C. Company.

For the support of this fellowship, which shall extend through a period of two years from the date of appointment of the fellow, the A. B. C. Glass Company agrees to pay fifteen hundred dollars ($1500) per year, payable annually to the university on the date on which the fellow begins work at the university. This sum shall be paid by the university in monthly installments to the holder of the fellowship.

Any and all discoveries made by the fellow during the tenure of this fellowship shall become the property of the A. B. C. Glass Company, subject, however, to the payment by them to the fellow of ten (10) per cent. of the net profits, to be commuted at the desire of either party through the arbitration provided for herein, arising from such discoveries, it being understood that the fellow shall be regarded as the inventor. At any time during the tenure of his fellowship the holder shall, at the option of the donor, take out patents at the expense of the donor on condition that at the time of making application therefor he shall assign his right to the donor under the conditions of this agreement. At or before the expiration of the fellowship, the business services of the fellow may be secured by the A. B. C. Glass Company for a term of three years on condition that the terms of such services are satisfactory to both parties at interest.

In the event of any disagreement between the donor and holder of this fellowship, it is understood and agreed that the chancellor of the university, or one whom he may appoint, shall act as arbiter as to all matters of fact, that his decisions shall be binding upon the parties at issue, and that they shall obtain such decision before having recourse to the courts.

It is also understood and agreed that during the tenure of this fellowship the holder may publish such results of his investigation as do not, in the opinion of the company, injure its interests, and that on the expiration of the fellowship the holder thereof shall have completed a comprehensive monograph on the subject of his research, containing both what he and others have been able to discover. A copy of the monograph shall be forwarded to the A. B. C. Company, and a copy shall be signed and placed in the archives of the university until the expiration of three years from that date, when the university shall be at liberty to publish it for the use and benefit of the people.

Signed on behalf of the University of Kansas.

.....

Date .....

Signed on behalf of the A. B. C. Glass Company.

.....

Date .....

There have been so far accepted by the university the following fellowships:

1. An Investigation into the Chemistry of Laundering, having for its object an improvement which will save in some measure laundered fabrics. It yields $500 a year, together with 10 per cent. of the net profits.

2. A Search for a New Diastase. The present source of the best diastase is expensive. The investigation has as a matter of fact developed into an attempt to make a new fodder upon scientific principles. It yields $500 a year and, under the original agreement, 10 per cent. of the gross proceeds for three years.

3. An Attempt to Utilize the Constituents of Waste Buttermilk, which, at present, in butter factories goes down the drains. These constituents, which it is desirable to conserve, are primarily caseine, and secondarily, lactic acid and sugar of milk. The fellowship yields $500 a year and ten per cent. of the net profits.

4. An Investigation into the Chemistry of Baking. This investigation was established by the National Association of Master Bakers, with the object not only of improving the chemistry of bread, but, as well, of providing for the association a trained expert upon whom they could afterwards rely. It yields $500 a year, together with a lump sum to be settled by arbitration, if necessary.

5. An Investigation into the Constituents of Crude Petroleum. I can not with propriety state the precise object of this investigation. The fellowship yields $1,000 a year and 10 per cent. of the net profits.

6. An Attempt to Improve the Enamel upon the Enamel-lined Steel Tanks used in all kinds of chemical operations on a large scale. This fellowship was established by the largest manufacturer of these tanks in the world. It yields $1,300 a year, together with an additional consideration to be decided upon, for the service rendered, by the chancellor of the university or one whom he may appoint.

7. An Investigation into the Relation between the Optical Properties of Glass and Its Chemical Constitution. This fellowship yields $1,500 a year and 10 per cent. of the net profits.

8. The Discovery of New Utilities for Portland Cement and of Improvements in Its Manufacture. This fellowship yields $1,500 a year and a large additional consideration dependent upon success.

The fellows for Fellowships Nos. 7 and 8 have not yet been selected. In addition to the foregoing fellowships there are certain others assured but not yet established:

9. An Investigation into Certain Glands of Deep-sea Mammals. It yields $1,500 a year and an additional consideration to be decided upon by arbitration. This fellowship is to be a benefaction.

10. The Discovery of New Utilities for Ozone. It yields $2,000 a year and 10 per cent. of the net profits.

The tenure of all fellowships is two years.

It is regrettable that in accordance with the terms of the agreement, it is impossible to publish at this time the results so far obtained. It may be said, however, that the progress of the fellows has been gratifying. It is significant in this connection that Fellowship No. 1, which expires shortly, is to be continued at *double the value* for three months, at the end of which time the donors will either take the fellow and his process into the factory or they will continue his fellowship through a third year at the increased amount; while with Fellowship No. 2 the donors have already indi-

cated their intention to continue it throughout a third year; the progress of the others has exceeded that of the first two and has surpassed expectations.

Most of these fellowships have arisen through letters of inquiry from the various companies. I have not gone out seeking fellowships in general. Had I done so it is not unreasonable to suppose that by this time there might have been from thirty to fifty. Owing to the fact that these fellowships have no relation to ordinary fellowships and that the scheme is essentially a new one, it has been deemed advisable to establish them at intervals. Proceeding in this way, and learning as one went, the scheme has undergone a natural and advantageous development. The degree to which it has been systematized, its effect upon the chemical department, the results of the relations of the different researches and reseachers to one another, and the wholly unexpected interactional relation of the donating companies to one another I shall reserve for a future communication. While it should be said that as yet this scheme of industrial fellowships is wholly experimental and tentative, it ought also to be said that the two years' experience has not shown that it is any other than a sane and practical relation between the university and industry to the advantage of all concerned.

Robert Kennedy Duncan
University of Kansas,
April 10, 1909

ELEMENTARY EMBRYOLOGY COURSES

The publication of Professor Lillie's "Development of the Chick," and the excellent character of his treatment of the subject, suggests comment upon the custom of using the chick for introducing students to embryology. Since the days of von Baer and before, the chick has been used for embryological study more than any other form. This has probably been due in part to its familiarity and to the ease of obtaining embryos of any desired age. Foster and Balfour's very valuable, though poorly written, "Elements of Embryology," based on the chick, for so long the only available text-book for immature students, fastened more firmly the custom of using the chick in introductory embryological courses. Now comes Lillie's fine treatment of the same subject, which is likely to establish the chick in almost undisputed possession of these courses.

Chick embryos are easy to obtain and easy to manipulate and much has been written about them; they also have decided resemblance to human embryos. Yet in spite of these advantages I can not but feel that chick embryos are peculiarly ill-adapted to the use of students beginning the study of embryology. The embryo chick is a highly specialized form adapted to a very peculiar environment within an egg shell and still further distorted from the general vertebrate type by the presence of the huge yolk mass. These special adaptations are of great interest, but it has been my experience that they assume an undue prominence in the minds of students and prevent their readily grasping the general phenomena of development of vertebrates, unless some less specialized form, as for example, the frog, has first been studied.

The first three years I taught elementary embryology we began with the chick and used it chiefly, if not exclusively. Since then, each year, after a brief consideration of the cell, its organs, and its behavior in mitosis, and a rapid survey of cleavage and gastrulation in half a dozen forms, we have taken up the embryology of the frog, using Marshall's "Vertebrate Embryology," modified and supplemented, of course, by the lectures. The laboratory work has covered the same ground as the classroom work. After completing the study of organology in the frog, two weeks to four have been given to the chick and two or three lectures to comparisons with the development of mammalia.

The point I would like to emphasize is that I have found that the students in these later courses got a far better grasp of the embryology of the chick in two weeks' study following careful work upon the frog, than they ever succeeded in obtaining when they began with the chick and devoted all the time to this subject, and of course they got a far more adequate conception of the embryology of verte-

brates. The difference in the results obtained by the two methods has been so great that I could not be induced to return to the former method. The course of the second type has, in its results, utterly outclassed that of the first sort at all points, even in pure training in observation, for observation must include a conception of the adaptations in the phenomena observed. Even students who plan to study medicine are, I am sure, far better prepared to study with intelligence human embryology than if they had given their attention wholly or chiefly to amniote embryos in which the space relations of the organs are so distorted by secondary influences.

Material for the elementary cytological work and the study of cleavage and gastrulation is easy to prepare and also can readily be purchased, and there is no difficulty, of course, in obtaining frog embryos and larvæ. The yolk in the earlier embryos necessitates careful work in preparing sections, but, by avoiding absolute alcohol and by using an oil that does not make the yolk too brittle, good preparations are readily obtained. The labor of preparing sections of frog embryos and larvæ seems no greater than that of preparing chick sections. At any rate, the labor is not such as to lead one, in order to avoid it, to choose less instructive material for study.

Perhaps no clearer text-book has ever been written than Marshall's "Vertebrate Embryology." In spite of some inaccuracies, and of not being up to date, it is still usable, but its cost is considerable, and it contains more than most introductory embryological courses can cover. Holmes's volume, "Biology of the Frog," gives insufficient treatment to the embryology, and Marshall's little book, "The Frog," is no more adequate on this side. Morgan's "Development of the Frog's Egg" is not adapted for an introductory embryological course. We greatly need an embryology of the frog. A revision of Marshall's chapters on this subject, and their publication as a separate volume would well meet this need. Were there such a volume obtainable, one would not fear harm from the publication of Lillie's "Development of the Chick," for courses of each type would then have a satisfactory text-book and an unbiased choice would be possible; but under present conditions one does fear that the very excellence of Lillie's book will serve to perpetuate an unfortunate tradition and will delay the general coming of embryological courses that are a better preparation for general morphological study.

M. M. METCALF

THE COUNTRY BOY AGAIN

IN SCIENCE, February 12, in discussing industrial education, I made the statement that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country. This statement was quoted from memory and was in error to the extent that I should have said 29 millions of our population instead of 29 per cent. Dr. Frederick Adams Woods, in SCIENCE, April 9, quotes this statement and adds some criticisms.

First, I want to assure Dr. Woods that I appreciate very fully the magnificent work he did in his study of heredity in royalty. It fell to my lot to review Dr. Woods's book, and I found it one of the most interesting treatises on heredity we have. He has demonstrated, I think, beyond cavil, that "native ability and natural impulses of human beings are as much a matter of heredity as are any physical characteristics."

The above quotation is from my review of Dr. Woods's paper in my article on Mendel's law, which will appear soon in Volume V. of the American Breeders' Association. In that review I say further:

> Prodigious effort has been made by the human race to better its condition but this effort has been wholly in the direction of improving the environment. While Dr. Woods has shown that it is really an unimportant factor in determining natural impulses and native ability, it is true that when environment is unfavorable it may prevent the development of natural tendencies or may warp them, and it may also result in great

natural ability remaining practically useless for a lack of the implements which a full development of intellectual power would place in its hands. But improving the environment does not from generation to generation give better material for our schools to work on.

I have only one criticism of Dr. Woods's reasoning. In studying heredity in royalty he purposely chose this class because it could be assumed that their characters were formed under the most uniform environment, which purpose was of course entirely legitimate. But it must be remembered that this environment is the best possible for the development of character and ability. It would be gratifying to me to see Dr. Woods make a similar study of some class of human beings subjected to an unfavorable environment. I believe he would find, as I have stated above, that even in that class native ability and natural impulses would prove to be purely a matter of heredity; but that character and actual ability would be found to be profoundly modified by environment. In fact, the whole experience of the human race speaks for this assumption. If the opposite were true, then why should the state go to the expense of maintaining schools, for a man's effectiveness would not depend on his environment, but upon his inheritance.

I have a further criticism to offer of Dr. Woods's article in SCIENCE. In the first place, the men listed in "Who's Who in America" do not represent leaders, although they include leaders. Dr. Woods's own figures prove the effect of environment as against heredity. For instance: under the initial A he finds 29.6 per cent. of city born individuals instead of the 16.1 per cent. expected on the basis of population. This merely shows that of the men in "Who's Who in America," those who have had the best opportunities have done best. "Who's Who in America" lists those men who have done something of note. I am inclined to believe that fully half of these men owe their success to their opportunities. They are not leaders, though they are competent workers, and they are not the type of men I had in mind in my previous article.

Census statistics do not easily lend themselves to the determination of the proportion of our population who actually live on farms. In rural population they include cities of considerable size. It has been said that "God made man, man made the cities, and the Devil made the country village." I have no way of ascertaining how many of the men who are distinctly leaders in this country were actually brought up on the farm. I am inclined to believe that the conditions in country villages and small towns are less favorable for the development of character than those on the farm or those in great cities.

I have not had time to secure extensive statistics on the birth-place of men who have been and are leaders in the various lines of activity in this country. In my previous article I merely repeated a statement I have heard frequently, and which I had never heard challenged. From the best statistics I can secure, about 36 per cent. of our population actually live on the farm at the present time. Of the 25 presidents of the United States, 23 of them were country bred, or were brought up under what the census terms rural conditions, only our present president and his immediate predecessor having been brought up in the city, so far as a hasty glance at history and biography reveals. This is 92 per cent. of the total, and there is no question that these men have been leaders. Of the present membership of the United States senate, in so far as the congressional directory reveals the facts, 70.5 per cent. are country bred. The statistics for the house of representatives are not so conclusive. The fact that many congressional districts are wholly city districts while others are wholly country districts vitiate the statistics for that branch of congress, so far as our purpose is concerned.

I hope to be able, in the not distant future, to present other statistics bearing on this question. I believe, however, that when we consider the fact that our country schools have always been vastly inferior to our city schools, the few data given above show that there is something in farm life, during the first few years of the boy's training, that tends more nearly to give normal expression to his hereditary talents and impulses than do con-

ditions of city or village life. The matter must rest here until further statistics are available.

W. J. SPILLMAN
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THE RELATION OF THE METER AND THE YARD

TO THE EDITOR OF SCIENCE: It is a matter of astonishment to me that so many men, authors of scientific books, are ignorant of the fact that the relation between the meter and the yard is in the United States fixed by law, viz., 1 meter = 39.37 inches. In England the established relation is 1 meter = 39.370113 inches. As examples, see "Fortie's Electrical Engineers' Handbook," 5th Ed., 1908, p. 1500, and "Eggleston's Tables of Weights and Measures," 4th Ed., 1900, p. viii, in both of which the archaic, inherited necessary relation, 1 meter = 39.37079 inches is adopted. In trade catalogues an error of this sort is not so serious and is occasionally made; but in a scientific publication it is unpardonable.

MARSHALL D. EWELL

SCIENTIFIC BOOKS

Primitive Secret Societies. A Study in Early Politics and Religion. By HUTTON WEBSTER, Ph.D., Professor of Sociology and Anthropology in the University of Nebraska. New York, The Macmillan Co. 1908. Pp. xiii + 227.

This book, which has served in its original form as a thesis for the doctorate in political science at Harvard University, treats, in eleven chapters, of the men's house, the puberty institution, the secret rites, the training of the novice, the power of the elders, development of tribal societies, functions of tribal societies, decline of tribal societies, the clan ceremonies, magical fraternities, diffusion of initiation ceremonies. The author's studies were concluded before he became acquainted with the late Dr. Heinrich Schurtz's "Altersklassen und Männerbünde" (Berlin, 1902), of which, however, he was able to make some use in the present monograph. The book of Schurtz, rather *tendenziös* in places and somewhat marred by a philological appendix, but, nevertheless, an interesting and valuable summary of facts, was preceded by Boas's (1895–7) investigations of the social organization and secret societies of the Indian tribes of the North Pacific coast (particularly the Kwakiutl), which still remain the best source of information for that region, as yet not adequately used by any authority. For the Plains tribes we have recent investigations by Wissler, Dorsey, Fletcher, Kroeber, and for the Pueblos Indians, those of Fewkes, etc. The material in Dr. Webster's book, as is the case with all others dealing generally with the topic of secret societies and ceremonies, is preponderatingly Australasian, Indonesian and African, though at pages 15–19 ("men's house"), 131–134 (age-societies), 147–159 (clan-ceremonies) and 176–190 (magical fraternities), the aborigines of the new world receive particular attention.

The author begins with the "men's house," described as follows:

> The men's house is usually the largest building in a tribal settlement. It belongs in common to the villagers; it serves as council-chamber and town hall, as a guest-house for strangers, and as the sleeping resort of the men. Frequently seats in the house are assigned to elders and other leading individuals according to their dignity and importance. Here the more precious belongings of the community, such as trophies taken in war or in the chase, and religious emblems of various sorts, are preserved. Within its precincts, women and children, and men not fully initiated members of the tribe, seldom or never enter. When marriage and exclusive possession of a woman do not follow immediately upon initiation into the tribe, the institution of the men's house becomes an effective restraint upon the sexual proclivities of the unmarried youth. It then serves as a clubhouse for the bachelors, whose residence within it may be regarded as a perpetuation of that formal seclusion of the lads from women, which it is the purpose of the initiation ceremonies in the first place to accomplish. Such communal living on the part of the young men is a visible token of their separation from the narrow circle of the family, and of their introduction to the duties and responsibilities of tribal life. The existence of such an institution emphasizes the fact that a settled family life with a private abode is the privilege of the older men, who alone have marital rights over the women of the tribe. For promiscuity,

either before or after marriage, is the exception among primitive peoples, who attempt not only to regulate by complicated and rigorous marriage systems the sexual desires of those who are competent to marry, but actually to prevent any intercourse at all of those who are not fully initiated members of the community (p. 1).

As men's houses, or as survivals thereof are cited the *eramo* of New Guinea, the Dyak *pangah*, the Formosan *palangkan*, the Dravidian (Oraon) *dhumkuria*, the Naga *morang*, the Polynesian *marae*, the Bechuana *khotla*, the Unyamwezi *iwanza*, the Bororó (Brazil) *baito*, the Pueblo *kiva*, the Hupa *taikyuw*, the Eskimo *kashim*, etc., but the unitary origin and service of all these is by no means demonstrated. According to Dr. Webster, "the presence in a primitive community of the men's house in any one of its numerous forms points strongly to the existence, now, or in the past, of secret initiation ceremonies." With some tribes the men's house "is used as the center of the puberty initiation ceremonies," and, "with the development of secret societies, replacing the earlier tribal puberty institutions, the men's house frequently becomes the seat of these organizations and forms the secret 'lodge.'" The men's house thus "serves a general purpose as the center of the civil, religious and social life of the tribe, and a special purpose as the abode of unmarried males." The first secret society is thus a "clan," which excludes women and boys. Next comes, apparently, the "puberty institution" with other subdivisions based on age and the recognition of its value to the community. Here the elders are in control and secret rites for the initiation of young men, their subjection to ordeals, and instruction in tribal wisdom and obedience (often in long periods of seclusion) appear to be "the characteristically social feature of primitive life," and "these mysteries, as the most conservative of primitive customs, provide an effective means of social control." These initiation ceremonies are tribal and communal machinery organized and conducted by the elders which can no longer operate when obedience to the tribes is replaced by obedience to the chief, and "initiation ceremonies, such as have been studied, retain their democratic and tribal aspects only in societies which have not yet emerged from that primitive stage in which all social control is in the hands of the tribal elders" (p. 75). And, "with increasing social progress, the powers of control are gradually shifted from the elders to the chiefs, and tribal societies charged with important political and judicial functions arise on the basis of the original puberty organizations." The new order of things brings with it limited membership, "degrees," "lodges," elaborate paraphernalia of mystery, etc. Secret societies may now "represent the most primitive movement towards the establishment of law and order," or may "embody the inner religious life of the tribe" and gather strength "from the pretended association of their members with the spirits and ghosts of the dead." Tribal secret societies arising through "a process of gradual shrinkage of the original puberty institution, in which, after initiation, all men of the tribe are members," often survive as "organizations of priests and shamans, in whose charge are the various dramatic and magical rites of the tribe" (p. 135). In connection with his argument at this point Professor Webster holds that "among the northwest tribes (of American Indians) the clan organization is in decay and secret fraternities in initial stages of development," and "among the tribes of the southwest the totemic clans have broken down to be replaced by numerous and well-developed magical fraternities," both statements open to serious objections, as to fact and also as to theory. In the rites of these magical fraternities too many "survivals of primitive puberty rites" are seen by the author; and the diffusion of such rites is perhaps not so extensive as he believes. The list of tribes possessing no puberty rites and, consequently, none of the social paraphernalia held to be developed from them would be of interest here. It is quite evident that even in primitive society there is something more than sex. It would be worth while knowing, as a contrast to the "men's house," how widespread and how "primitive," *e. g.*, is the

maloca, a characteristic house of the Indians of northwestern Brazil, recently described by Dr. Koch-Grünberg.[1] The *maloca's* inhabitants are mostly one family, often an old couple with their grown-up sons and their families, etc. They number from 10 to 100 individuals, all under the same roof, and the author testifies to the good-behavior and morality of them all. Owing to the practise of extra-tribal marriage it frequently happens that women speaking absolutely distinct languages live in the same *maloca.* In it also are celebrated some of the great dance-festivals. The sick are cared for within its walls and the dead interred beneath the floor. The *maloca* is thus as far removed from the "men's house," as can well be imagined, and it exists among very primitive folk. This serves to illustrate the relativity of some of the ideas and institutions involved in the discussion of "primitive politics and religion." The esoteric element, though often notable and significant, has probably been overestimated in the history of human evolution.

In the opinion of the reviewer, the author will add to the value of his interesting book if, in a second edition, he makes an index and presents the bibliography in alphabetical order at the close and not as now in rather distracting though instructive footnotes.

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Unsere Ahnenreihe. (*Progonotaxis hominis.*) *Kritische Studien über phyletische Anthropologie.* By ERNST HAECKEL. Jena, Gustav Fischer. 1908.

This quarto memoir of fifty-seven pages is, as its title-page indicates, a Festschrift in honor of the 350th anniversary of the Thuringian University at Jena, the celebration of which was made the occasion for the transference to the university of the "Phyletic Museum" founded by Professor Haeckel, "das erste Museum für Entwicklungslehre." The occasion was naturally propitious for a consideration of that most interesting of all phyletic problems, the descent of man, and in the memoir before us Professor Haeckel has traced the various steps, as he conceives them, through which the line of ascent has passed from the moners to man. What is presented is, however, almost entirely a repetition of the material to be found in chapters XIX.–XXIII. of the "Evolution of Man," a work that has already been noticed in these columns,[1] and it is not until toward the close of the memoir that any new contribution to the question is to be found. Here, after some notice of *Pithecanthropus* as the "missing link" and a paragraph devoted to *Homo primigenius,* under which term are included the Neander, Spy and Krapina men, one finds a description of the most striking peculiarities of a skull of an Australian aborigine from Queensland, which Professor Haeckel regards as "the most remarkable human skull of the many thousand with which anthropology has concerned itself." He considers it as representing a reversion to the ancestral *Homo primigenius,* and for this reason creates for its original possessor the species *Homo palinander* (=*Homo primigenius recens! -atavus?*).

Five plates, giving views of the norma frontalis, occipitalis, verticalis, basalis and lateralis of this skull, together with those of *Homo sapiens* (*germanus*), *Anthropithecus niger, Hylobates mulleri* and *Cynocephalus mormon,* complete the memoir and are beautiful examples of photographic reproduction. A sixth plate, the series of mammalian embryos familiar to all readers of Haeckel's works, hardly requires comment.

It may be remarked, however, that the author's predilection for the coinage of new terms in order to give definiteness to his concepts, finds expression in the memoir, but hardly with as happy results as usual. For the terms *Homo neander, H. spyander* and *H. krapinander,* consistent as they are orthographically, are certainly most inconsistent etymologically.

J. P. McM.

[1] "Das Haus bei den Indianern Nordwestbrasiliens," *Archiv für Anthropologie,* 1908, N. F., VII., 37–50.

[1] SCIENCE, N. S., Vol. XXII., 1905.

Introduction to the Rarer Elements. By Philip E. Browning, Ph.D., Assistant Professor of Chemistry, Yale University. Second edition, thoroughly revised. New York, John Wiley & Sons. 1908. Pp. x + 207, 2 plates.

The first edition of this book was reviewed in these columns in 1903.[1] After five years it has been revised, much new material being added. This is especially the case in regard to the radio-elements, the excellent chapter upon that topic being contributed by Professor Boltwood, a colleague of the author.

While the book is teeming with information, it does not pretend to be a compendium. However, one feels the lack of proportion when he observes that forty-nine double chlorides of cæsium (p. 11) are mentioned and only one oxide of rubidium is named. The statement is made (p. 63) that metallic præseodidymium and neodidymium have not been separated. Muthmann accomplished this very cleverly several years ago and his method has been applied successfully in the reviewer's laboratory. Good crystals of metallic thorium have also been obtained by another method, namely, reduction by aluminium, published in the Year Book of the Carnegie Institution. It is not mentioned. A satisfactory method for separating zirconium and aluminium (p. 78) published fifteen years ago is not incorporated. Nor is the only good method for separating zirconium and titanium (by hydrogen dioxide) given. The chapter on the uses of the rarer elements is in much need of revision. The recent work on scandium is not included.

The colored plate of the spectra is a good illustration of the printer's art, but the small plate on the absorption spectra is poorly chosen, in fact, is incorrect. Additional plates would be helpful, as well as a general discussion of some of the principles involved in the fractionation of these "complexes of elemental matter," as Crookes put it. There is an index, but it is inadequate.

The book must have served a good purpose and every library of chemical works should have a copy, for the term "rare earth" does not frighten teacher or student quite as badly as formerly. This is due in large part to a book of such rightness of purpose as is this one.

Chas. Baskerville

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[1] Science, N. S., XVIII., 497.

SCIENTIFIC JOURNALS AND ARTICLES

The American Museum Journal for March contains the following articles: "The Darwin Celebration," with views of the bust of Darwin presented to the museum by the New York Academy of Sciences; "New Habitat Groups of North American Birds," six in all, with an illustration of each. These groups mark the highest point reached in presenting to the public an accurate idea of the bird life of various parts of our country; they have been made possible by the liberality of a number of friends of the museum and of the public. A notice of "The Annual Meeting of the Trustees" notes that the present endowment fund is $2,048,156, and that last year the museum expended $115,488, and the city $159,930. There is a letter from Mr. Stefansson, on "The Stefansson-Anderson Arctic Expedition," and an account of "Recent Purchases of Fossil Vertebrates."

The Museums Journal of Great Britain for February has an article on the "Victoria and Albert Museum," reviewing the recent report on its rearrangement, classification of its material, relations of the national museums to one another, and on the general policy of the institution. Most interesting is the account given by Rev. J. S. Whitewright of "Pioneer Museum Work in China." The models, diagrams and maps, many of them large and elaborate, were made on the spot by Chinese artisans. The number of visitors—there were 69,745 in thirty-six days—shows the success of the work. Robert Standen tells how to make and use "Glue and Turpentine Cement for Alcoholic Mounts." There are the customary reviews and notes.

SPECIAL ARTICLES

A LITTER OF HYBRID DOGS

Several years ago the writer had the opportunity of observing the results of a cross be-

tween two "thoroughbred" dogs. The breeds were sharply contrasted in many characters and the results were so striking that an effort has been made to collect the data regarding the offspring, from the owner of the dogs. While the data thus obtained are of course very incomplete, they are considered of sufficient interest to merit a brief record. Practically nothing of a scientific character appears to have been done in this very interesting field for students of heredity.

The mother of the cross in question was an Old English Bobtailed Sheep Dog and the father a Scotch Collie so-called. Both were typical specimens of their respective breeds. The dogs were accompanied by a guarantee

	Mother	Father	Pup No. 1	Pup No. 2	Pup No. 3	Pup No. 4	Pup No. 5	Pup No. 6
Color.	Grizzly throughout except white breast.	Black and tan, breast white, body jet-black, legs tan from feet to first joint.	Black, breast and paws white.	Blue-gray throughout, except white breast and paws.	Body black, legs light tan.	Body black, legs light tan.	Dark brown, except white breast.	Large patches of white and light yellow over whole body. Fore legs white, hind yellow.
Character of coat.	Long and shaggy over whole body, including eyes, face and legs.	Heavy and wavy.	Shaggy, hanging over eyes, face and legs (mother) but very wavy (father).	Shaggy, long, wavy hair over whole body, including eyes, face and legs.	Hair short and smooth.	Hair short and smooth.	Thick, wavy hair over whole body, including face and legs.	Hair short and smooth.
Tail.	None. No projecting bone.	Long and bushy, jet-black.	About four inches long.	About four inches long.	About eight inches long.	About eight inches long.	Six inches long with a kink in the middle.	Long and bushy, yellow.
Eyes.	Dark brown.	Light brown.	Dark brown.	Dark brown.	Light brown.	Light brown.	Dark brown.	One wall eye, one light brown.
Disposition.	Very gentle and timid.	Playful and aggressive.	Gentle and timid (mother) but at times inclined to snap (father).	Very gentle.	Very aggressive.	Gentle.	Aggressive.	Very timid.
Legs and body.	Body long, legs long. Hind legs very short from feet to hock, but very long from hock to hip.	Legs ordinary length and shape.	Like mother.	Like mother.	Like father.	Like father.	Like mother.	Like father, but smaller.
Shape of head.	.....	.....	Like mother.	Like mother.	Like father.	Like father.	Like mother.	Like father, but smaller.
Sex.	.....	.....	Male.	Male. Like No. 1, except in color.	Male.	Female. Just like No. 3 except disposition.	Male.	Female.

that they were thoroughbred, and were brought from England to Nova Scotia by an English gentleman for the purpose of crossing them to produce a dog for farm purposes.

I had occasion to observe both dogs carefully for a considerable period, and I also owned one of the pups for several years. The pups were born in June, 1894. I am, of course, aware of the dangers of collecting *post facto* data and have therefore included here only such facts as I can verify with certainty from my own recollection. The data given under "legs and body" and "shape of head" are of course only general impressions of a probably more or less blended condition.

The accompanying table shows some of the contrasting characters in the parents and the offspring. The most striking contrasts are afforded by the color and character of the coats, the presence and absence of the tail, and its variability in the offspring, and by the dispositions, that of the mother being very gentle and timid, while the father had the aggressive collie disposition. The litter contained more than six pups, but these are the only ones which can now be sharply and definitely characterized. It is a noteworthy fact that several of them are in pairs which are very closely alike, differing markedly in only one character so far as observed. Numbers 1 and 2 were alike except in color, one having the general color of the mother, and the other that of the father but without any tan. Numbers 3 and 4 constituted another very clearly marked pair, differing widely from the others in many characters and yet so closely alike that they were scarcely distinguishable, except in their dispositions, which were quite unlike. This recalls some cases of identical human twins. These animals were not of the same sex, however.

In comparing the characters of the offspring with those of the parents it will be seen that in no character was there complete dominance of one parent in all the offspring. In coat color the father dominated in all but two, in one of which (No. 2) the color was that of the mother. The long, shaggy coat, covering the face and legs as well as the body, appeared in Nos. 1 and 2 of the offspring, except that the effect of the wavy hair of the father was also more or less evident. In No. 5 the coat more nearly resembled the father, but in Nos. 3, 4 and 6 was quite unlike either parent, being short, smooth and sleek. The differences in eye color may not be significant, as the collies' eyes range from light to dark brown, and in the sheep dogs a wall eye is not uncommon and is considered typical of the breed.

The inheritance of the tail character is of considerable interest, showing as it does a range from the long bushy tail of the father to a condition approaching its complete absence as in the mother. The intermediate tail lengths can not be attributed wholly to inheritance from the father, however, for dogs with more or less of a tail are said to occur frequently in the pure sheep-dog breed. How the tailless condition originated appears to be unknown, although various statements and conjectures are made in dog books concerning this matter. Two breeds of bob-tailed collie, with tails 5–10 cm. long but otherwise in every particular like the collie, are recognized in certain parts of England[1] (II., p. 440). Walsh[2] says (p. 221):

> Until within the last half-century sheep dogs without tails were exempt from taxation, it being supposed that no one would keep a tailless dog who could afford to pay the tax. As a consequence almost every sheep dog had its tail cut off, and owing to this cause the tailless sheep dog, still met with in some localities, is supposed to have arisen. . . . It is far more probable that the bob [in pointers] is derived from a cross with the bull dog, which is subject to the natural loss of tail in a greater or less degree, and was probably used to give courage to the pointer. . . . Usually these "bobs" [the old English sheep dog] are strongly made and symmetrical dogs, but without any definite type; they have frequently a tendency to the brindle colour, which favours the theory of the derivation of short tails from the bull dog though it cuts equally against a similar derivation in the pointers, in whom the brindle is absolutely

[1] "Dogs of All Nations," 2 vols., London, 1905, illustrated.

[2] Walsh, J. H., "The Dogs of the British Islands, etc.," 5th edition, London, 1886, pp. 292, illustrated.

unknown. Not being able to arrive at any definite type of the "bob-tail," I shall not attempt to describe him.

From this writer it would appear that the Old English Bob-tail is a recent, or at least variable and poorly characterized breed. Lee[3] states, however, that Reingle's picture in the "Sportsman's Cabinet," very early in the last century, is typical of the breed as at present known, showing that this breed has probably existed for at least a century. He further states that it is possibly older than the collie. The varieties in England and Scotland are said to be identical, except that the latter usually has a long tail, the reason attributed for this being that the owners have steadfastly refused to amputate it! It is stated that in England many of these dogs are born either without tails or with very short ones, pups with and without tails usually occurring in the same litter. The tails may be docked so that no one can tell that the animals were not born tailless. They are said to be jet-black at first with white markings, in a few weeks becoming "silvery-lilac."

This writer argues that the antiquity and concentration of the strain is shown by the fact that if there is a strain of this breed in such breeds as the retriever, lurcher or spaniel many generations back, a typical specimen will occasionally appear.

In the "Dogs of All Nations" already referred to, which is a standard authority on the good and the bad points in the various breeds of dogs, giving their characterization according to the various dog clubs and breeders, a black and tan or brindle coat is considered a fault in the Old English Bobtail breed (*l. c.*, II., p. 471).

Such remarkable diversity as here described in a single litter of offspring could not be accounted for by the effect of external conditions of development and must therefore be due to differences of some sort in the germ cells of either or both parental individuals. No one character is present in all the offspring to the exclusion of its homologue. There is a decided tendency in any given character for the offspring to "take after" one parent or the other, though in certain cases, as in the character of the hair in Nos. 3 and 4, there is a marked departure from either parent. This is perhaps the reappearance of a character derived from some cross in the ancestry of one of the breeds.

One further fact worthy of mention is the disposition of dog No. 1. I had him in my possession for several years and often observed the usually very subdued and timid behavior, and at times the sudden and unexpected change to the aggressive attitude of his father. It will be noted that some of the dogs inherited the aggressive disposition of their father and others the timid and gentle disposition of their mother.

R. R. GATES

UNIVERSITY OF CHICAGO,
April 2, 1909

[3] Lee, Rawdon B., "A History and Description of the Modern Dogs of Great Britain and Ireland (Non-sporting Division), etc.," London, 1899, pp. 428.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION E—GEOLOGY AND GEOGRAPHY

SECTION E, Geology and Geography, of the American Association for the Advancement of Science, met Monday morning, December 28, 1908, at Johns Hopkins University. The section organized at 11 A.M., immediately after the adjournment of the general meeting of the association. The first five papers of a Symposium on Correlation were given during the morning and afternoon sessions on Monday. This symposium was continued on Tuesday and Wednesday under the auspices of the Geological Society of America.

Professor J. P. Iddings, of Chicago, gave his vice-presidential address, "The Study of Igneous Rock," on Monday, at 2:30 P.M.[1]

According to the custom for several years past, Section E adjourned Monday P.M., but its fellows and members were cordially invited to be present at the sessions of the Geological Society of America, December 29 to 31, 1908, and at those of the Association of American Geographers, January 1 and 2, 1909.

Following the dinner of the Geological Society of America on Wednesday evening there was a discussion of the relations that should obtain

[1] SCIENCE, Vol. XXIX., pp. 202–217.

between Section E and the Geological Society of America and the Association of American Geographers. This was done in order that the officers of the three geologic-geographic organizations may be able to plan future meetings for the reading of papers and for field excursions, so that the needs and wishes of all geologists and geographers may be met as fully as possible.

On Thursday evening, December 31, Dr. Albrecht Penck, professor of geography at Berlin University and Kaiser Wilhelm professor at Columbia University, delivered a public address on "Man, Climate and Soil," given under the auspices of the Association of American Geographers.

The Society of Vertebrate Paleontologists held its meeting during the week, an account of which has been given in SCIENCE.[2]

SYMPOSIUM ON CORRELATION

Monday, December 28

Pre-Cambrian.

C. R. Van Hise, "Principles of pre-Cambrian Correlation."

F. D. Adams, "The Basis of pre-Cambrian Correlation."

Discussion.

Early and Middle Paleozoic.

C. D. Walcott, "Evolution of Early Paleozoic Faunas in Relation to Their Environment."

Discussion.

A. W. Grabau, "Physical and Faunal Evolution of North America in the Late Ordovicic, Siluric and Devonic Time."

Discussion.

Stuart Weller, "Correlation of Middle and Upper Devonian and Mississippian Faunas of North America."

Discussion.

Tuesday, December 29

Late Paleozoic.

G. H. Girty, "Physical and Faunal Changes of Pennsylvanian and Permian in North America."

David White, "The Upper Paleozoic Floras, Their Succession and Range."

Discussion.

Vertebrates.

S. W. Williston, "Environmental Relations of the Early Vertebrates."

H. F. Osborn, "Environment and Relations of the Tertiary Mammalia."

Discussion.

[2] Vol. XXIX., pp. 194–198 and 376.

Mesozoic and Tertiary.

T. W. Stanton, "Succession and Distribution of Later Mesozoic Invertebrate Faunas."

Discussion.

W. H. Dall, "Conditions Governing the Evolution and Distribution of Tertiary Faunas."

Ralph Arnold, "Environment of the Tertiary Faunas of the Pacific Coast."

Discussion.

Wednesday, December 30

Tertiary and Quaternary.

F. H. Knowlton, "Succession and Range of Mesozoic and Tertiary Floras."

Discussion.

R. D. Salisbury, "Physical Geography of the Pleistocene with Special Reference to Conditions Bearing on Correlation."

D. T. MacDougal, "Origination of Self-generating Matter, and the Influence of Aridity on its Evolutionary Development."

Discussion.

T. C. Chamberlin, "Diastrophism as the Ultimate Basis of Correlation."

The following note on the symposium on correlation, was prepared by Mr. Willis, for the secretary's report of the Baltimore meeting:

In accordance with the announcement made in SCIENCE, December 18, 1908, a symposium on correlation was presented at the Baltimore meeting under the auspices of Section E and the Geological Society of America. The object proposed was a discussion of the physical and biological criteria of correlation, and the influences of the physical upon the biological. While most of the papers presented were mainly paleontological, there was generally throughout the papers and the discussions an undercurrent of thought with reference to this relation of cause to effect. In some cases decided emphasis was placed upon the relation of faunas and floras to environment.

Messrs. Van Hise and Adams presented two views concerning the criteria of correlation of the pre-Cambrian and the classifications which result from their application. Van Hise maintained the validity of the dual classification of the pre-Cambrian, and, after discussing the value of lithologic similarity, stratigraphic similarity and unconformities for matching strata, applied these methods to the North American pre-Cambrian with results which he has elsewhere published recently. Adams approached the problem as a part of the record of continental history and based a tentative classification of the pre-Cambrian upon possible parallel events in North

America and Eurasia. In discussion Van Hise pointed out the similarities between the two sets of conclusions.

The correlation of the major part of the Paleozoic was discussed by Messrs. Walcott, Grabau and Weller, whose papers comprised the period from Cambrian to Mississippian, inclusive. Walcott followed conservatively the lines of classification laid down in his earlier papers on the Cambrian of North America. He felt obliged by the state of investigations to confine his discussion largely to evidence afforded by the brachiopods and indicated that more elaborate conclusions might be suggested by a similar thorough study of the trilobites and other elements of the faunas. Grabau discussed the faunas and sediments of Ordovician, Silurian and early Devonian times, together with certain phases of the paleogeography and climatic conditions, especially of New York and Michigan. Weller stated that during Middle and Upper Devonian time the faunas of North America occupied three provinces, the eastern continental, interior continental and the western continental. The provincial conditions continued into early Mississippian time, but gave place to more cosmopolitan conditions through the development of the great Mississippian province, with sub-provinces east of the Cincinnati arch and also in the western part of the continent.

The late Paleozoic and early Mesozoic were discussed by Messrs. Girty, David White and Williston, with reference, respectively, to the invertebrate faunas, the floras and the vertebrates. Girty considered chiefly the relations of the Pennsylvanian and possible Permian faunas of North America, and their correlation with the Permian of Russia. White brought out the world-wide distribution of certain late Paleozoic floras and touched upon the paleogeographic relations essential to their distribution.

Williston was followed by Osborn, who discussed the Cenozoic vertebrates, and in the discussion of their two papers the value of vertebrate paleontology in its bearing upon former land connections was distinctly apparent.

In discussing the succession and distribution of the later Mesozoic invertebrates, Stanton considered late Jurassic, Lower Cretaceous and Upper Cretaceous faunas in their bearing upon the geography of those periods. A problem of peculiar difficulty is presented by the marked distinction which exists between the Lower Cretaceous fauna of the gulf region and that of the Pacific coast, in spite of the fact that in Mexico a Pacific fauna invades the western margin of the province that was usually occupied by the gulf fauna. In order to explain these relations it appears to be necessary to recognize the probable existence of a southern extension of the land area of Arizona and its partial submergence first from the east and then from the west.

In discussing the conditions governing the distribution and evolution of Tertiary faunas, Dall emphasized the importance of temperature of marine waters and showed that in so far at least as Tertiary and existing faunas are concerned, it formed the dominant condition limiting the migration or continuance of the fauna. Following Dall in the discussion of Tertiary faunas, Arnold gave a detailed analysis of the Tertiary of the Pacific coast, and exhibited maps showing the geographic conditions at various stages from Eocene to Pliocene.

Closing the consideration of the historic succession, Knowlton discussed Mesozoic and Tertiary floras, Salisbury brought out those phases of physical geography of the Pleistocene which had special relations to conditions bearing on correlation, and MacDougal presented a consideration of the origination of self-creating matter and the influence of aridity upon its evolutionary development.

The symposium was closed by Chamberlin, who discussed diastrophism as the ultimate basis of correlation. The speaker emphasized the view that diastrophism is the basal phenomenon according to which other phenomena that afford criteria for correlation are modified and developed. Taking a broad view of the whole subject, he held that the periodicity of diastrophic movements affords the criteria for determining the major divisions, but he recognized also that all the related lines of evidence are required to work out the minutiæ of the problems of geologic correlation.

In connection with the discussions paleogeographic maps of North America at fifteen different periods were exhibited. They represented studies by Willis in association with a number of colleagues in regard to the geologic provinces of North America.

The arrangements for the symposium on correlation included one unusual feature, inasmuch as a definite time schedule was prepared and published in the program, and this schedule was strictly adhered to during three days' proceedings. In general, about three quarters of an

hour was allowed for the presentation and discussion of each topic; the principal speaker took thirty minutes or less; the remainder of the time was given to discussion of the subject as presented by him. The following speaker was not allowed to begin until the hour stated on the program had arrived. This plan appeared to work to the satisfaction of the audience; the speakers confined themselves practically to the time allotted, and their convenience and that of all who had an interest in the subject was satisfactorily served.

The papers contributed to the symposium will appear in the *Journal of Geology* of Chicago University, in chronological order.

Monday morning at 11 A.M. in a subsection, with G. K. Gilbert as chairman, the following papers were read:

Some New or Little-known Geological Terms and their Application in Stratigraphic Writing: A. W. Grabau.

The following terms were discussed and defined:

1. *Disconformity,* proposed by Grabau in 1905 to cover unconformable relation of strata where no discordance of dip exists, the term *unconformity* being restricted to cases with perceptible discordance of dip.

2. *Rudaceous* and *rudyte, arenaceous* and *arenyte, lutaceous* and *lutyte,* proposed by Grabau in 1904 for pebbly, sand and mud rocks, respectively, irrespective of their composition; classification of clastic rocks by texture being advocated. According to composition we may have: *silicirudytes, silicarenytes, silicilutytes; calcirudytes, calcarenytes, calcilutytes; argillutytes,* etc.

3. *Chronofauna* and *chronoflora* and *locofauna* and *locoflora* (new), the first two for fauna and flora of a given time period, the other two for the fauna and flora of a locality.

4. *Epiplankton* (new) for organisms attached to floating objects and not primarily planktonic. There have been included under this term *pseudoplankton,* which it is proposed to restrict to dead organic and to inorganic planktonic matter.

5. *Epicontinental sea* to be restricted to the shallow seas lying within the continents and constituting with the *mediterraneans* the *intracontinental seas.* The term littoral to be applied as in zoology to the district extending from high water to limit of sun-illuminated bottom (edge of continental shelf in the oceans) and characteristic of oceans, intracontinental seas and lakes. The term epicontinental sea is not to be applied to the littoral district of the oceans as thus defined.

6. *Migration* to be active—in search of food, escape from enemies, etc.; *dispersal* to be passive—by currents, water or air, etc., or by carriage by other organisms, etc.

This paper was discussed by G. K. Gilbert.

Some Preglacial Valleys in Eastern New York and Their Relation to Existing Drainage: John H. Cook.

The valley of the Mohawk from Schenectady to the Hudson River is of post-glacial origin, as shown by the fact that between Niskayuna and Fort's Ferry it crosses a filled channel, trending north-northeast towards Round Lake and south towards Albany (at which city this channel probably opens into the Hudson valley).

For two miles above Schenectady borings along the Mohawk developed no rock at a depth considerably below the rock bottom of the river at the entrance to the upper gorge near Rexford Flats.

The channel of the preglacial Mohawk lies beneath the sediments of glacial Lake Albany, but may be traced approximately. It parallels, roughly, the Helderberg escarpment and probably reaches the Hudson just north of Coeyman, where there is a break in the rock wall elsewhere almost continuously exposed for several miles north and south of that point.

Drift and sands and clays deposited during the retreat of the ice sheet had filled these channels and spread widely over the divides when the re-excavation of the Hudson valley and the draining of Lake Albany were accomplished. The waters of Lake Iroquois still found outlet through the Mohawk valley as far as Schenectady, but, as a point near Rexford Flats lay at an elevation below the level of the deposits immediately south and west, the stream there poured over the low divide, crossed the filled channel mentioned above and took the course it now pursues to the Hudson.

This paper was discussed by G. K. Gilbert and F. P. Gulliver.

Monday afternoon, following the vice-presidential address of J. P. Iddings on "The Study of Igneous Rocks," the reading of papers was continued.

The Metamorphism of Glacial Deposits: Frank Carney.

Till and tillite are two extremes in the structure of glacial deposits.

So far as we yet know, the periods of glaciation are spaced by long lapses of time; therefore we have only disconnected data in the metamorphic cycle of glacial sediments.

Evidence is adduced tending to show: (1) That some chemical activities are accentuated by the saturated condition of sediments beneath an ice-sheet. Carbonation and hydration would be enhanced, and even oxidation may occur. (2) That the great pressure to which unconsolidated materials of an earlier drift sheet are subjected by a later invasion of ice is an important agent of alteration. This pressure based on a conservative estimate of the thickness of the ice amounts to over nine thousand pounds per square inch. Not only are these materials made compact, but they are faulted and jointed. Furthermore, this density increased capillarity which has operated in more recent alterations. In addition to the pressure of a superincumbent ice-mass, it is probable that hydration has increased the pressure-effects.

This paper was discussed by George D. Hubbard.

A New Occurrence of Carnotite: EDGAR T. WHERRY.

A supposed occurrence of autunite at Mauch Chunk, Pa., has been investigated, and the material found to be similar in character to the Colorado carnotite. It occurs in layers of conglomerate at the top of the Mauch Chunk red shale on the west side of the Lehigh River, one mile north of the town, having been extracted from intercalated lenses of black shale and graywacke and deposited in fissures and porous beds by circulating surface waters. The dark color of these lenses is due, not to carbon, but to the presence of comparatively fresh hornblende, biotite, etc., resulting from the disintegration of the metamorphic rocks of the highlands to the south and east, during the arid climate prevailing in late Mississippian times, and much of the vanadium and uranium originally distributed through these rocks is concentrated in them. As the western deposits of carnotite occur in similar positions, namely, in arenaceous formations overlying red shales, it is suggested that they may have had a similar origin.

The Phenomena of Æolian Sand Drift: E. E. FREE.

Wind-drifted sand moves by "saltation" or in a series of leaps in a manner quite analogous to that recently described by McGee for the suspended matter of streams. The forms shown by collections of such sand are of two main types: (1) the large heaps or dunes, (2) the minor surface figures, of which ripples form the best example. Previous discussions of dune formation are satisfactory except that far too little importance has been assigned to the eddy behind the dune. Many anomalous forms can be explained as due to it. Ripple formation is probably connected with the production in the moving air of eddy systems analogous to the Helmholtz vortex-surface.

This paper was discussed by C. H. Richardson, George D. Hubbard, J. H. Cook, G. K. Gilbert and F. P. Gulliver.

The following papers were read by title.

The Mills Moraine, with Some General Remarks on the Glaciation of the Longs Peak Region of Colorado: EDWARD ORTON, JR.

The Longs Peak group is a mountain mass with several summits, lying in front or east of the continental divide and connected with it by one narrow and much-dissected ridge or spur. The district is very wild and rough and existing maps are of the most elementary sort and furnish no accurate details. The highest peak is 14,271 feet high and the mass as a whole, towering 1,000 or 1,500 feet above the general summit level of the main range of the Rockies, is easily the dominating point of northern Colorado.

Separating the main range and the Longs Peak group are deep gorges occupied by the head waters of the Big Thompson and the St. Vrain rivers. The heads of these gorges, winding around behind Longs Peak, cut deeply into the connecting ridge, and have nearly isolated the group from the main range, of which it was once an integral part.

The high valleys and cirques lying between the main range and the western slopes of the Longs Peak mass, offered an excellent gathering ground for snows, owing to the great elevation of the peak and the position of the gorges with reference to the prevailing winds and storms. Great glaciers developed there, and made their way out north and south, curling around to the eastward past the base of the great peak on either side, and building magnificent moraines along their flanks and termini. The nature, location and general topographic features of these moraines is discussed, and some evidences of periodicity in their development is noted.

On the east side of the Longs Peak group, located in a small cirque between the three highest summits, a small but very active glacier has been at work, and has built up a very beautiful moraine system, entirely independent of the general glaciation of the district. On account of this isolation, these moraines offer a very good opportunity for a study of the periodicity of the glacial phenomena of the mountain areas of the west.

A topographic map drawn from original surveys of the gorge of this, the Mills glacier, and the moraines which it built, has been prepared.

The Red Beds of the Wichita-Brazos Region of North Texas:[3] C. H. Gordon.

The region to which this paper relates is of special interest as having furnished the data for the discussions on the Texas Permian which have appeared in various publications in recent years. In the study of the underground water conditions of the region under the auspices of the U. S. Geological Survey, it was observed that the red sandy shales and red sandstones so conspicuous in the Wichita valley region were replaced southward in large part by blue shales, light-colored sandstones and limestones. In some places the transition from a sandstone into a limestone was plainly seen. Formations to which the names Wichita and Clear Fork have been given, when traced along their strike toward the southwest, are found to grade into those included under the terms Cisco and Albany. The former have been regarded as Permian, while the latter have usually been assigned to the Pennsylvanian. Some authors, however, have suggested that the Albany should be considered Permo-Carboniferous. An abundant marine fauna characterizes the beds toward the south. In the Red Bed region marine forms are few, appearing only in the few beds of limestone that persist. Along with them in this region appear vertebrate remains upon which the references to the Permian have been based. It is the conclusion of the author that the Red Beds of this region are the near-shore representatives of the Albany and the decision as to their age will rest upon that of the latter.

The Invertebrate Faunas and Correlation of Some So-called Permian Rocks of the Mississippi Valley, with Remarks on Their Stratigraphy: J. W. Beede.

Discussion of the stratigraphy, fossils and correlation of the higher Paleozoic rocks of Kansas and Nebraska and their correlation with rocks of the United States and Eurasia. Remarks on stratigraphy and paleophysiographic conditions under which faunas lived, and a few fundamentals of paleontologic correlation.

Differential Effects of Eolian Erosion upon Rock-belts of Varying Induration: Charles R. Keyes.

The desert regions of our country may be regarded as comprising those tracts where the annual amount of rainfall is less than ten inches. More than nine tenths of whatever rainfall there is sinks at once into the dry and thirsty soil and does not appear as stream-water at all. The only perennial rivers are those whose headwaters are extralimital and whose courses merely traverse the arid region on the way to the sea. With so small and unimportant precipitation characteristic of the arid country, the high evaporation, often several times greater than the amount of annual rainfall, and the loose dry soils, wind-scour becomes a far more potent erosive agency than is usually fancied.

The sequence of geologic terranes and their lithologic characters in the desert region, and particularly in the northern part of the Mexican tableland where the isle-like aspects of the mountain ranges dotting a vast sea of earth is so characteristic of what the Germans in the South African deserts have so aptly termed the "Inselberglandschaft," are such as to permit eolian influences to fashion their finest subjects of desiccate sculpture. Ten thousand feet of hard limestones are succeeded by an even greater thickness of soft shales and friable sandstones. On account of frequent and profound faulting which, in early Tertiary times, the region had undergone and the subsequent planing off of the country to the condition of a peneplain, there has been imparted to the areal distribution of the geologic formations a remarkable alternation of belts of resistant and weak rocks.

General desert-leveling and lowering of an elevated country by deflation is comparable in the nature of its larger relief effects to that of general corrasion in a humid climate. It is in the arid region that the eolian influences as erosional processes find their maximum activities. In the dry lands the weaker rock-masses are rapidly removed; while the harder belts long resist deflative attack. Under conditions of aridity, the differential effects of wind-scour, or deflation, upon rock-belts of contrasted induration are very different from what they are in a normal moist climate. The inequalities of surface relief are in consequence very much more intensified than when stream-action is the chief eroding agent. In general, it may be estimated that in the case of hard rock-masses in an arid land deflative erosion is probably less than one tenth as efficient as in a normal wet country water-action would be; while in the case of weak rocks it is more than ten times greater. This is, no doubt, one of the principal reasons why to most observers in the desert regions such manifest evidences of enormous ero-

[3] Published by permission of the director of the United States Geological Survey.

sion are so impressive on every hand, while the recognized absence of an abundance of running waters makes it appear that the progress of erosion must be extremely slow.

In southwestern United States, where the lofty and numerous desert ranges have been regarded as having developed out of an old peneplain, a remnantal portion of which seems to be represented in the great Mesa de Maya, where through faulting and folding there has been produced a rapid succession of resistant and weak rock-belts, where deflative phenomena are thought to be typically expressed, and where there are several large rivers flowing from the humid zones of the higher Rockies in deep canyons through to the sea, there appears to be all of the data at hand by which to measure not only the relative rapidity of deflation upon contiguous areas of hard and soft rocks, but also to gauge the comparative effects between erosion by direct deflation and erosion by corrasion unaided by extended chemical decomposition of the rocks at the surface.

Locus of Maximum Lateral Deflation in Desert Ranges: CHARLES R. KEYES.

Deflative erosion in an arid land is preeminently plains-forming. Its general effects are best likened to the work of the sea along an exposed coast where there is carved out of the shore a marine platform. In a smaller way, as a detritus-laden stream impinges against its banks, forming high bluffs or cliffs, so in the dry regions the swiftly moving air-current heavily charged near the ground with sands and dusts tends to wear away fastest the least sheltered portions of the desert hills and mountains.

The air-currents of the desert are both strong and constant. Their transportative powers have never been measured quantitatively. When transportation is active the "sandstorm" results. The personal discomfort to the traveler in a sandstorm is so very great that he is usually oblivious to all else. The volume of soil flowing along the surface of the ground during one of these storms must be prodigious. Compared with the amount of sediments carried along by some large river, as the Mississippi in time of flood, it is estimated that in the lower twenty feet of the deflation-stream there are equal amounts of rock-waste moving in like cross-sections of the great river and of the air-stream of the desert. The air-stream moves forty miles an hour instead of four, as in the case of the water-stream; and in place of being only a mile wide the path of the sandstorm is several hundreds of miles in width. The lower six inches of the air-stream is almost wholly moving sand and fine gravel. The finer dust soars upwards thousands of feet, darkening the light of the sun as by a heavy thunder-cloud.

Over surfaces of drifted sands and of weak rocks the erosion is mainly accomplished by a trituration of the particles of the heavily sand-laden bottom stratum of moving air. Whenever bare or hard rock-masses are encountered there is vigorous sand-blast action. Thus, hypsometrically, among the desert ranges which are all composed of very hard rocks usually devoid of a soil-mantle, the notably exposed zone is at the very base of the mountains, or immediately above the surface level of the surrounding plains. This is probably the chief reason why there are no foothills flanking the mountain ranges of the desert, why mountain and plain so sharply meet, and why the bases of the desert ranges are often so abrupt and straight as to suggest at once the presence of fault-scarps as an explanation of the steep faces to the mountains.

When we institute search for direct evidences of fault-lines which are supposed to give rise to the escarpments, we usually look in vain. Although the mountain may be a faulted block the movement, however profound, is commonly discovered to be of ancient date. Its fault-plane is found to be far out in the plain, often at distances of four or five miles. The intervening space has a smooth and gently sloping rock-floor and has every appearance of a marine plain of denudation from which the sea has but recently retired. McGee[2] notes many such plains with extensive rock-floors fashioned from the hardest rocks, among the desert ranges of Sonora in Mexico. Others are described more in detail in the New Mexican region.[3] They are now widely known throughout the arid lands of the west. Thus, in the general leveling and lowering of the desert region anciently faulted and planed off so as to present alternating belts of resistant and weak rocks the areas of the latter are worn chiefly downward by the wind-action, but the hard mountain belts which have emerged from the softer areas are attacked laterally; and the zone of maximum eolation is at and just above the general plains-level.

A New Trachodon from the Laramie Beds of Converse County, Wyo.: CHARLES H. STERNBERG.

A complete skeleton, except hind feet, one tibia and fibulæ and tail vertebræ. It lies on its back

[2] *Bull. Geol. Soc. America,* VIII., p. 87, 1897.
[3] *Ibid.,* XIX., p. 78, 1908.

and the soft cross-bedded sand contains the impression of the skin that entirely envelops the bones, which are nearly all in normal position. The contents of the stomach are also preserved. It will be mounted as in death by the American Museum of Natural History.

Isobases of Post-Algonquin Elevation Across Lakes Michigan and Huron: J. W. Goldthwait.

The results of precise measurements of altitude of the Algonquin beach, during the last four years, are here summarized.

With data collected last summer for the Canadian Geological Survey, isobases of the deformed water-plane are constructed over the region east of Lake Huron and Georgian Bay in Ontario. It is found that at the south end of Lake Huron the Algonquin beach is horizontal, and twenty-five feet above the present lake; that forty or fifty miles north of Sarnia the beach begins to rise towards the north-northeast, at a rate which increases slowly to three feet per mile over Lake Simcoe, and then very rapidly north of Orillia to five feet per mile near the pre-Cambrian border. Beyond that, to North Bay, the warping seems to have been much more irregular.

The attitude of the deformed Algonquin plane, south of the pre-Cambrian boundary in Ontario, is compared with that over the north half of Lake Michigan, three hundred miles away. Isobases drawn across Lakes Michigan and Huron emphasize the close correspondence in the details of post-Algonquin uplifts in these two regions.

Conclusions are drawn as to: (1) The regularity of the uplifts over the Great Lake region, south of the pre-Cambrian border; (2) the southern limit of the uplifts; (3) the original altitude of Lake Algonquin above sea level and (4) the cause of the uplifts.

Sand and Gravel Resources of Nebraska: G. E. Condra.

This paper is now in press. It consists of 210 pages of text and 82 figures in Part 3 of Vol. 3, Nebraska Geological Survey.

The Glacial Character of the Yosemite Valley: F. E. Matthes.

The Yosemite is a stream-worn canyon modified by ice erosion. That it is primarily a product of stream cutting no one familiar with its relations to the rest of the Merced River canyon, and with the position which the latter occupies in the series of great transverse valleys of the Sierra Nevada, will question. That it has been invaded by glaciers, on the other hand, and has to some extent been remodeled by them, is amply attested by the threefold record of glaciation, viz., the moraines, striæ and glacial sculpture in and about the valley. The glacial character of the Yosemite is however by no means equally pronounced throughout: most accentuated at the upper end, it rapidly fades downvalleyward and ultimately vanishes at the lower end. This gradation is explained by the circumstance that the valley lay close to the periphery of the glaciated zone of the Sierra. In earlier glacial times the ice advanced considerably beyond the foot of the valley, but the later glaciations appear to have been more moderate, the ice front seldom reaching down to the "gateway." The lower portion of the valley bears therefore no fresh signs of glaciation, and since the older icework has been considerably obliterated by subaerial erosion, its glacial character can now scarcely be detected except by the trained eye. The upper half of the valley, Tenaya Canyon and the Little Yosemite, on the other hand, having suffered more frequent, more intense and also more recent glaciation, have been extensively remodeled and present today a glacial aspect of the most pronounced and clear cut type.

The disparity between the lower and upper portions of the Yosemite is further heightened by the presence in the latter of a variety of aberrant sculptural features. The ice had to deal here with rock-masses of singularly variegated structure, ranging all the way from the schistose to the massive. Since ice accomplishes most of its work by plucking, its effectiveness as a sculpturing agent is largely determined by the fissility of the materials it attacks. Its action in the Yosemite was therefore necessarily a selective one, guided and controlled locally by the direction, attitude and distribution of the joints. Thus it was permitted to achieve large results where the intensity of the fissuring favored plucking, as in the region about the Cathedral Spires, while it found itself almost powerless against such huge masses of unjointed rock as Mt. Broderick, El Capitan or the Cathedral Rocks. Again, the remarkable wall-like smoothness as well as the orientation of the cliffs over which the waterfalls plunge, reflects the strong directive influence of the rock structure.

LIST OF PAPERS READ BEFORE THE GEOLOGICAL SOCIETY OF AMERICA

Abstracts of these papers have been sent to Science by the secretary of the Geological Society of America.

President Calvin's address, "The Latest Phase of the Pleistocene Problem in Iowa."

Physical and Structural

Some Distinctions between Marine and Terrestrial Conglomerates: JOSEPH BARRELL.

The Chemistry of the Pre-Cambrian Rivers: REGINALD A. DALY.

The Primary Origin of the Foliated Structure of the Laurentian Gneisses: FRANK D. ADAMS and ALFRED E. BARLOW.

Relations of Present Profiles and Geologic Structure in the Desert Ranges: CHARLES R. KEYES.

Deflation and the Relative Efficiencies of Erosive Processes under Conditions of Aridity: CHARLES R. KEYES.

Unconformity Separating the Coal-bearing Rocks in the Raton Field, New Mexico: WILLIS THOMAS LEE.

Evidence that the Appalachian and Central Coal Fields were once Connected across Central Kentucky: ARTHUR M. MILLER.

The Bearing of the Tertiary Mountain Belt upon the Origin of the Earth's Plan: FRANK BURSLEY TAYLOR.

On Faults: HARRY FIELDING REID.

Mass Movements in Tectonic Earthquakes: HARRY FIELDING REID.

The Alaskan Earthquake of 1899: LAWRENCE MARTIN.

A Recent Landslide in a Shale Bank near Cleveland accompanied by Buckling: FRANK R. VAN HORN.

The Volcano Kilauea: C. H. HITCHCOCK.

Mt. Pelé of Martinique and the Soufrière of St. Vincent in May and June, 1908: EDMUND OTIS HOVEY.

Glacial

Multiple Glaciation in New York: H. L. FAIRCHILD.

Glacial Waters West and South of the Adirondacks: H. L. FAIRCHILD.

Correlation of the Hudson and the Ontarian Glacier Lobes: H. L. FAIRCHILD.

Pleistocene Features in Northern New York: H. L. FAIRCHILD.

Pleistocene Geology of the Southwestern Slope of the Adirondacks: W. J. MILLER.

Weathering and Erosion as Time Measures: FRANK LEVERETT.

The Glacial Phenomena of Southeastern Wisconsin: WM. C. ALDEN.

Concerning Certain Criteria for Discrimination of the Age of Glacial Drift Sheets as Modified by Topographic Situation and Drainage Relations: WM. C. ALDEN.

Lake Ojibwa, the Last of the Great Glacial Lakes: A. P. COLEMAN.

Glacial Erosion on Kelley's Island, Ohio: FRANK CARNEY.

Interglacial Epochs: ALBRECHT PENCK.

Stratigraphic

The Chalk Formations of Northeast Texas: C. H. GORDON.

Geologic History of the Ouachita Region: E. O. ULRICH.

Some Results of an Investigation of the Coastal Plain Formations of the Area between Massachusetts and North Carolina: WM. BULLOCK CLARK.

The Geologic Relations of the Cretaceous Floras of Virginia and North Carolina: EDWARD W. BERRY.

Occurrence of the Magothy Formation on the Atlantic Islands: ARTHUR BARNEVELD BIBBINS.

Erosion Intervals in the Tertiary of North Carolina and Virginia and Their Bearing upon the Distribution of the Formations: BENJAMIN L. MILLER.

The Character and Structural Relations of the Limestones of the Piedmont in Maryland and Virginia: EDWARD B. MATHEWS and J. S. GRASTY.

Recurrence of the Tropidoleptus Fauna and the Geographic Range of Certain Species in the Chemung of Maryland: CHARLES K. SWARTZ.

The Geological Distribution of the Mesozoic and Cenozoic Echinodermata of the United States: WM. BULLOCK CLARK and M. W. TWITCHELL.

On the Age of the Gaspé Sandstone: HENRY S. WILLIAMS.

Revision of the Paleozoic Systems in North America: E. O. ULRICH.

The Aftonian Sands and Gravels in Western Iowa: B. SHIMEK.

An Aftonian Mammalian Fauna: S. CALVIN.

The Brachiopod of the Richmond Group: A. F. FOERSTE.

Areal

The Trap Sheets of the Lake Nipigon Basin: ALFRED W. G. WILSON.

Reconnaissance in Arizona and Western New Mexico along the Santa Fé Railroad: N. H. DARTON.

Geologic Studies in the Alaska Peninsula: WALLACE W. ATWOOD.

Our Present Knowledge of the Oklahoma Red Beds: C. N. GOULD.

Paleontologic

The Fauna of the Glen Park Formation: Stuart Weller.

Petrologic

Some Features of the Wisconsin Middle Devonic: H. F. Cleland.

A Classification of Crystals based upon Seven Fundamental Types of Symmetry: Charles K. Swartz.

Quartz as a Geologic Thermometer: Fred. E. Wright and E. S. Larsen.

The Use of "Ophitic" and Related Terms in Petrography: Alexander N. Winchell.

Ice-borne Bowlder Deposits in mid-Carboniferous Marine Shales: Joseph A. Taff.

Chemical Composition as a Criterion in Identifying Metamorphosed Sediments: Edson S. Bastin.

Petrography of the South Carolina Granites (Quartz Monzonites): T. L. Watson.

Physiographic

Tertiary Drainage Problems of Eastern North America: Amadeus W. Grabau.

Pre-Glacial Drainage in Central New York: H. L. Fairchild.

Some Physiographic Features of the Shawangunk Mountains: George Burbank Shattuck.

Nantucket Shorelines III.: F. P. Gulliver.

Nantucket Shorelines IV.: F. P. Gulliver.

Note on Striations and U-Shaped Valleys Produced by other than Glacial Action: Edmund Otis Hovey.

Cartographic

Paleogeography of North America: Charles Schuchert.

Historical Notes on Early State Surveys: George P. Merrill.

Economic

The Iron Ores of Maryland: Joseph T. Singewald, Jr.

The Shortage of Coal in the Northern Appalachian Field: I. C. White.

Symposium on Correlation

Principles of Pre-Cambrian Correlation: C. R. Van Hise.

The Basis of Pre-Cambrian Correlation: F. D. Adams.

Evolution of Early Paleozoic Faunas in Relation to Their Environment: C. D. Walcott.

Physical and Faunal Evolution of North America in the late Ordovicic, Siluric and Devonic Time: A. W. Grabau.

Correlation of Middle and Upper Devonian and Mississippian Faunas of North America: Stuart Weller.

Physical and Faunal Changes of Pennsylvanian and Permian in North America: G. H. Girty.

The Upper Paleozoic Floras, Their Succession and Range: David White.

Environmental Relations of the Early Vertebrates: S. W. Williston.

Environment and Relations of the Cœnozoic Mammalia: H. F. Osborn.

Succession and Distribution of Later Mesozoic Invertebrate Faunas: T. W. Stanton.

Conditions Governing the Evolution and Distribution of Tertiary Faunas: W. H. Dall.

Environment of the Tertiary Faunas of the Pacific Coast: Ralph Arnold.

Succession and Range of Mesozoic and Tertiary Floras: F. H. Knowlton.

Physical Geography of the Pleistocene with Special Reference to Conditions Bearing on Correlation: R. D. Salisbury.

Origination of Self-generating Matter and the Influence of Aridity upon Its Evolutionary Development: D. T. MacDougal.

Diastrophism as the Ultimate Basis of Correlation: T. C. Chamberlin.

Relationship of the Pennsylvanian and Permian Faunas of Kansas and Their Correlation with Similar Faunas of the Urals: J. W. Beede.

Glacial Character of the Yosemite Valley: François Matthes.

Age and Geologic Relations of the Sankaty Beds, Nantucket: W. O. Crosby.

Age and Relations of the Sankaty Beds: H. W. Shimer.

The Mills Moraine with some Discussion of the Glacial Drainage of the Longs Peak (Colo.) District: Edward Orton, Jr.

List of Papers Read before the Association of American Geographers

A short account was sent to Science by the secretary of the Association of American Geographers.[1]

President Gilbert's address, "Earthquake Forecasts."

Professor Albrecht Penck gave a lecture on "The Relation between Climate, Soil and Man," on Thursday evening, December 31.

Round Table Conference on Geography for Secondary Schools: Richard Elwood Dodge.

[1] Vol. XXIX., pp. 273–275.

Some Undescribed Features of the Yellowstone National Park: WILLIAM LIBBEY.
Accumulation of Inherited Features in Shorelines of Elevation: J. W. GOLDTHWAIT.
The Origin of Loess Topography: G. E. CONDRA.
The Stream Robbery on which the Belle Fourche Reclamation Project is Based: N. H. DARTON.
Delta Form and Structure of the Thames River Terraces, Connecticut: F. P. GULLIVER.
On the Elements of the Surface Sculptured by Valley Glaciers: WILLIAM HERBERT HOBBS.
Existing Glaciers of the Western Hemisphere: O. D. VON ENGELN.
Map Criticism: CYRUS C. ADAMS.
The Topographer's A B C of Land Forms: FRANÇOIS E. MATTHES.
The Principles of Topographic Delineation: FRANÇOIS E. MATTHES.
The Topographic Base Map of Alaska: ALFRED H. BROOKS.
The Requisites of a School Wall Map: J. PAUL GOODE.
How may the Teaching of Geography in Elementary Schools be Improved? C. T. MCFARLANE.
On Apparatus for Instruction in the Interpretation of Maps: WILLIAM HERBERT HOBBS.
Three Gatherings of Geographic Interest: ALBERT PERRY BRIGHAM.
Status of the Magnetic Survey of the Earth: L. A. BAUER.
A Reconnaissance in the Arctic Slope of Alaska: ERNEST DE KOVEN LEFFINGWELL.
The Climate of Cuba: HENRY GANNETT.
The Temperature at Great Heights above the American Continent: A. LAWRENCE ROTCH.
The Cyclonic Unit in Climatological Investigations: R. DEC. WARD.
The Climate of the Historic Past: ELLSWORTH HUNTINGTON.
Origin of Civilization Through Intermittency of Climatic Factors: J. RUSSELL SMITH.
The National Forest Policy: HERBERT A. SMITH.
A Proposed Ecological Survey in Illinois: HENRY C. COWLES.
Decrease in Population in the Plateau Region of Central New York: RALPH S. TARR.
Locations of Towns and Cities in Central New York: RALPH S. TARR.
Some Anthropogeographic Effects of Glacial Erosion in the Alps: N. M. FENNEMAN.
Results of Recent Census of Cuba: HENRY GANNETT.
The Anthropography of Some Great Cities: MARK JEFFERSON.
The Capacity of the United States for Population: ALBERT PERRY BRIGHAM.
The Reservoir Systems of Flood Protection in the Light of the Recent Floods of the Mississippi River: ROBERT M. BROWN.
Geographical and Other Influences Affecting the Pottery Industry of Trenton, N. J.: RAY HUGHES WHITBECK.
Geographical Influences in the Development of Ohio: FRANK CARNEY.
Trade Routes in the Economic Geography of Bolivia: ISAIAH BOWMAN.
The Geography of Wisconsin: LAWRENCE MARTIN.
The Geographic Distribution of Culture: MARK JEFFERSON.
The Influence of the Precious Metals on American Exploration, Discovery, Conquest and Possession: GEORGE DAVID HUBBARD.
Some Practical Results of the Ninth International Geographical Congress: H. G. BRYANT.
A Remarkable Glacial River and Its Modern Representative: F. B. TAYLOR.

The Baltimore meeting was one of great interest to geologists and geographers, not only on account of the large number of papers presented, many of which had to be read by title, but also because there were so many opportunities to meet men from different sections of the country and to discuss and compare individual fields of work, without which great advance in science can not be made. Great credit should be given to the members of the Geological Department of Johns Hopkins University for the arrangements of the details of the meeting.

F. P. GULLIVER,
Secretary Section E

SOCIETIES AND ACADEMIES

TWENTY-FIFTH MEETING OF THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-fifth meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago on Friday and Saturday, April 9 and 10, 1909. The attendance upon the various sessions numbered over sixty, including forty-six members of the society. On Friday evening forty members dined together in the café of the university commons, and discussed informally various topics of interest, including the plans for the meeting of the British Association for the Advancement of Science to be held in Winnipeg this summer, and the next International Congress of Mathematicians to be held in England in 1912.

Particular interest centered in the report of the committee appointed at the previous meeting, of which Professor E. J. Wilczynski was chairman, and whose purpose was to devise a plan by which it might be possible for the society to aid in securing better methods of making mathematical appointments in the colleges and universities of this country. The paper read by Professor Wilczynski at the preceding meeting was published in full in SCIENCE for February 26, 1909. The committee reported that they had been unable to recommend for consideration any plan for improvement by action of the society. But, nevertheless, the members of the section were greatly interested in the details of a plan proposed by Professor Wilczynski and formally requested the secretary to incorporate this in the minutes of the meeting.

Twenty-six papers were presented at the four half-day sessions of the section, all of the authors being present except Dr. Ranum and Professors Ames and Davis, whose papers were read by title.

Following are the titles of papers and the authors:

On a Class of Discontinuous Functions of Two Variables: Professor C. N. HASKINS, University of Illinois.

The Fermat Number $2^{256}+1$: Mr. A. E. WESTERN, London, England; Dr. J. C. MOREHEAD, Northwestern University.

A Simplification of Lagrange's Method for the Solution of Numerical Equations: Dr. J. C. MOREHEAD.

Oscillations near Lagrange's Equilateral Triangle Points in the Problem of Three Bodies: Mr. THOMAS BUCK, University of Chicago.

On the Equivalence of Pairs of Quadratic Forms under Rational Transformations: Professor L. E. DICKSON, University of Chicago.

The Group of Classes of Quadratic Integers with Respect to a Composite Ideal as Modulus: Dr. ARTHUR RANUM, Cornell University.

On Surfaces having Isotherm-conjugate Lines of Curvature: Professor A. E. YOUNG, Miami University.

A Set of Criteria for the Summability of Divergent Series: Professor W. B. FORD, University of Michigan.

On the Determination of the Asymptotic Developments of a Given Function: Professor W. B. FORD.

A Class of Periodic Orbits of Three Finite Bodies: Mr. H. E. BUCHANAN, University of Chicago.

Automorphisms of Order Two: Professor G. A. MILLER, University of Illinois.

The Attack on the Space and Time Concepts by Einstein and Minkowski: Mr. R. P. BAKER, University of Iowa.

An Imaginary Conic: Professor E. W. DAVIS, University of Nebraska.

Groups of Rational Integral Transformations in a General Field: Dr. L. I. NEIKIRK, University of Illinois.

A Theory of Invariants: Professor L. E. DICKSON.

Combinants: Professor L. E. DICKSON.

Maschke's Symbolic Method Applied to some Questions in Geometry of Hyperspace: Mr. W. H. BATES, Purdue University.

A Simpler Proof of Lie's Theorem for Ordinary Differential Equations: Professor L. D. AMES, University of Missouri.

Periodic Orbits about an Oblate Spheroid: Dr. W. D. MACMILLAN, University of Chicago.

On the Effect of Types of Correspondence on Bravais's Coefficient of Correlation: Professor H. L. RIETZ, University of Illinois.

Oscillating Satellites when the Finite Bodies Describe Elliptic Orbits: Professor F. R. MOULTON, University of Chicago.

Projective Differential Geometry of Developables: Professor E. J. WILCZYNSKI, University of Illinois.

Complete Elementary Theory of Certain Properties of Classes of Functions: Mr. ARTHUR PITCHER, University of Chicago.

Remarks on the General Theory of Point Sets: Mr. T. H. HILDEBRANDT, University of Chicago.

Biorthogonal Systems: ANNA JOHNSON PELL, University of Chicago.

On the Solution of Linear Differential Equations with Periodic Coefficients: Professor F. R. MOULTON, Dr. W. D. MACMILLAN, University of Chicago.

H. E. SLAUGHT,
Secretary of the Section

THE TORREY BOTANICAL CLUB

THE meeting of March 9, 1909, was called to order at the American Museum of Natural History at 8:30 P.M., with Dr. E. B. Southwick in the chair. About fifty persons were present. After the reading and approval of the minutes of the preceding meeting, the club listened to a very interesting lecture on "Ferns," by Mr. Ralph C. Benedict. The lecture was illustrated by lantern slides made from photographs taken by the speaker.

PERCY WILSON,
Secretary